

April 15, 1957

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AVIATION WEEK

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PUBLICATION

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ICEGUARD by Goodyear
To Fly on The Boeing 707



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The Boeing 707, commercial jet transport, will fly with the most advanced type of ice protection on all three leading edge surfaces of its huge wingpan.

Financed by Goodyear!

Embodiment revolutionary electrothermal systems of ice protection—developed through the assistance of the National Research Council of Canada and Goodyear—now system of the Iceguard has already been in lengthy service above the Arctic Circle on the Canadian Avro CF-105 all-weather fighter.

Now the other has been selected by Boeing for jet transport service.

For information on the system twin-tail Iceguard—how these two systems of hotproof ice protection can be applied to air wings, wings, propellers, antennas, pipes, conductors—where ice presents a problem—write: Goodyear, Aviation Products Division, Akron 18, Ohio, or Los Angeles 56, California.

ICE PROTECTION BY



When Research and Development work is Advanced America's Greatest Product is The Race for Air Power

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One of a kind!

Kids still love jackknives, but no longer seem to do much whittling. Like the even bigger the whittling machine seems to be one more variety of this high-Q, triple-exhaustion age.

The production capacitor also has lost its enthusiasm for whittling metal. Machining from solid bar is still a necessity when making one part or a few prototypes. But, for hundreds of parts, extruded shapes save cost and machining time.

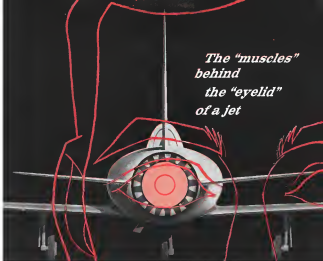
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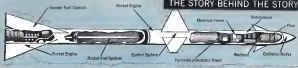
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Aircraft Division

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THE STORY BEHIND THE STORY



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check-out takes specialized technicians many hours. Under stress of enemy attack, a small but fatal defect might be missed.

IN MINUTES, NOT HOURS, all critical parts can now be checked by remote personnel—or specialists—simply by pressing buttons on touch-sensitive RACE spines. Connected in minutes, RACE flashes diagnosed faults on television-like screen and automatically spots trends and indicates repair instructions.



IN FLIGHT, RACE checks guided direction for correct target, performance at the peak capacity expected. Into it, with all components functioning, tag to give missile best possible opportunity to reach and destroy objective.

"RACE" TO BOOST MISSILE STRIKING POWER

Electronic System Cuts Launching Time, Ups Dependability

When a rifle bullet misses you simply fire another. Guided missiles, however, are costly and complex, packed with precision parts in hair-line adjustment. When these "birds" take off, they've got to fly right the first time!

At present, making rare missiles perform properly takes hours, even days, of careful tuning by highly trained crews. And under the stress of actual combat, the best-trained crew might neglect an important check-point—and there are thousands of potential trouble-spots in a typical missile.

Sperry's new missile testing system called RACE does the job in only minutes—with little chance for error. RACE (for Raytek Automatic Check-out Equipment)

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Designed to test supersonic aircraft as well as missiles, RACE will strengthen our national defense by keeping key weapons fit to fight.

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Great Road, New York
 DIVISION OF SPERRY RAND CORPORATION



AVIONICS... from A not quite to Z

THE line of products for missiles, aircraft or commercial applications with which Bell Aircraft's newly-formed Avionics Division is concerned does not quite span the alphabet. It ends with VHF. But it's all inclusive and complete—indicating a highly experienced organization capable of dealing successfully with any of the hundreds of electronic, electro-mechanical or mechanical systems and devices which make up the field of Avionics.

It has creative engineering ability for research and development—and efficient manufacturing facilities. It is competent to design and produce

complete systems—or independently operating units for such systems—or arrangements for both.

It's an organization with size and experience to qualify it for any avionics project—with every assurance to assure to its capabilities. One of its recent developments is the Navy's Automatic Carrier Landing System which makes precision landings possible with zero-visibility conditions.

The services of this organization are available to defense agencies, private contractors and commercial organizations. If you have problems in Avionics, Bell engineering representatives are at your service to help resolve them.

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From MOOG... **Advanced Electro-Hydraulic
Servo Components**

Moog is the industry's leading producer of electro-hydraulic servo valves. This leadership has been achieved by advanced valve design resulting in high performance, high quality, reliability and efficient manufacture. The same creative approach applied to industry's severe

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These recent achievements in the creation of advanced custom designed electro-hydraulic servo components are evidence of Moog's continuing progress.



SERVO VALVE

• These proportional "dry motor" electro-hydraulic servo valves feature high dynamic response, accuracy, linearity and reliability. Light-weight and compact, they are also available in custom designed versions for special or advanced applications.

DUAL INPUT SERVO VALVE

• This new component provides for simultaneous electro-hydraulic control by receiving mechanical and electrical inputs without increased use of mechanical linkages. Use of an entirely new design offers improved performance, superior adaptability and saving of space and weight.

SERVO ACTUATOR UNIT

• Custom designed integrated assemblies include actuating cylinder, electro-hydraulic servo valve and feedback sensor device. In a closed loop, receiver the actuator is a function of its position.

MOOG



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The pilotless bomber is powered by a Pratt-Whitney Aircraft J57 turbojet engine equipped with a Holley compressor bleed governor. It flies in a semi-circular arc above the weather over the longest range yet possible by a missile in the free world today.

Like all Holley engine controls, the compressor bleed governor is dependable, easy to service, compact and lightweight—five vital qualities for aviation equipment.



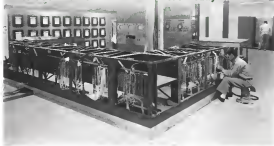
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- INSTALL** prefabricated cable and connect to terminal hardware in schedule with project activities.
- CHECK OUT** the cable system to guarantee compatibility of cable installation with the overall function of the system.
- DOCUMENT** the complete cable system, including drawings, break-down into components covering consideration to replacement of elements that may be used as building blocks for future addition to the system.

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A Strong Step Forward

Formation of a three-man Airways Modernization Board as proposed to President Eisenhower by Edward P. Curtis, his special assistant for aviation facilities planning, is a strong step forward toward ultimate solution of the air traffic control problem.

This board can avoid many of the administrative deadlocks and pitfalls of the previous governmental machinery, that has shared so long without much positive result. It can also serve an extremely useful function in keeping the development and coordination of a joint military-civil traffic control and navigation system going in the interim that will inevitably occur before a major and final overhaul of the government aviation agencies can be accomplished.

Interim Nature

It is necessary to understand the essential interim nature of the Airways Modernization Board if its value is to be obtained properly by the industry and government agencies concerned. The AMB cannot be of any more date help in untangling the traffic control snarl. That is the job of the Civil Aeronautics Administration.

Improvements during the next 15-30 months are dependent on the program proposed by CAA Administrator James T. Pyle for which appropriation requests are now before Congress. If the Congressional critics of the traffic control snarl want immediate action they can best ensure it by full support of the current CAA aviation and navigation appropriation requests.

Nor can the AMB cause the emergence of the ultimate automatic navigation and air traffic control system that will be required in another decade to handle the twin problems of a vastly expanded civil air traffic and an ultimately more complicated air defense problem. That can come only after the major overhaul of government aviation agencies has been completed. We expect Mr. Curtis will have more to say about this reorganization in his final report to the President.

Readers of *Airport Week* will find no startling surprises in the interim report of Mr. Curtis. He notes, as we have intimated during the past several years, that the air traffic control problem is genuine and will grow worse if not dealt with promptly. "The alarm which has been voiced in the past faces many sources it is in fact supported by evidence that our aviation and terminals are subject to increasing congestion," Mr. Curtis reported to the President. Mr. Curtis also relies on conclusions that the principal enabling block in achieving more progress in this field is not technical development but the administrative snarl of the current interagency machinations of the federal government.

"I found there was no lack of scientific ideas," Mr. Curtis reported. In fact, an overabundance of electronic

systems had been developed in the laboratory to improve our terminal and en route operations. Most of these have been drafted and never used.

"The key to this dilemma must be found in the organizational arrangements in the executive branch which are intended to set goals, to develop and to select the system and methods which will meet these goals. The problem of modernizing the aviation was clearly recognized in 1948 as one that required urgent action. The action taken since then have not been effective."

The three-man AMB with one representative each from the Department of Defense and Commerce plus a director backing, prudentially appointed chairmen should avoid the administrative obstacles that worried two earlier air navigation development boards and caused the better known VOR/DME battle. At the same time the new AMB will not interfere with the quick fix program CAA, under the leadership of Pyle, is already pushing to ease the traffic control pressure during the next few years. There is a "gray area" where the current CAA program ends and the new AMB proposed program would begin to intrude. But with the present CAA leadership and the will to make progress that most doubts into the new AMB, this probably will not become a serious problem.

Technical Forum

The new AMB will not and should not prevent strong arguments over the relative merits of various proposed navigation and traffic control systems. This type of technical debate is vitally necessary to speed progress. What the AMB can do is to provide a uniformly selected forum for these debates and the mechanism of getting quick, sound decisions on the controversies.

The private pilots, airline passengers, airline management, USAF and Navy and all of the other elements that want and need a progressively improving solution to the traffic control problems now have a clear cut program that they can support.

Fast and foremost they should push for complete and speedy execution of the current CAA program that will eliminate congestion in the air for the next two to three years. Second they should push for the creation of the Airways Modernization Board, as proposed by Mr. Curtis and recommended to Congress by President Eisenhower and support the board fully when it brings into action. Third, they should work with interest Mr. Curtis's final report to the President on the major overhaul of government aviation agencies required for the ultimate solution of the problem.

—Robert Hiltz



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Consisting essentially of a heat-sensing element and a transistor-triggered control unit, the Kidde Aircraft Fire Detector is the first to give both an immediate needle overload danger signal and a fire alarm when temperature reaches a critical degree. Its hermetically-sealed control unit needs no shock or vibration isolation, has no vacuum tubes, and the entire unit requires no resetting after a fire. Here's how it works:

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However, if there is a sudden flash of fire in the nacelle, the control unit interprets the rapid rise in temperature as a definite danger condition, and a FIRE ALARM is actuated. The pilot then operates

the nacelle fire extinguishing system to put out the blaze.

During any gradual temperature rise above maximum normal, the ABNORMAL TEMPERATURE signal remains operative all through the rise, and is replaced by the FIRE ALARM when a predetermined fixed fire temperature has been reached.

Lightweight and compact, the Kidde Aircraft Fire Detector can be adapted to meet the needs of all aircraft produced today. For more information, write Kidde now.

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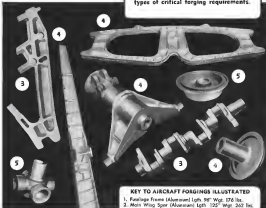
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WHO'S WHERE

In the Front Office

William E. Zander, formerly senior vice president and director of Alcoa Manufacturing Co., a division, Kalle Corp., Los Angeles, Calif.

Sheldon M. Finkelm, founder and head chairman, retired president of Fawcett Cannon and Tooling Corp., Bryant N. Y. Mr. Finkelm succeeds John H. Cough, retired.

Robert F. Goss, a vice president, Vipe Industries, Inc., Beverly Hills, Calif.

Gen. Lemmon C. Gough (USAF, ret.), assistant Defense Products Group Executive, Aerospace Division, C. Tinsley Co., Los Angeles, Calif.

Andrew H. Higgins, vice president, Avco-Whitcomb, D. C. office, Standard Oil Co., a division of General Dynamics Corp., Rochester, N. Y.

Robert F. Williams, Jr., Washington, D. C. representative, Kellert Aircraft Corp., Harrison, Pa.

Carl Norman P. Rice (USAF, ret.), in charge of metal fabrication, Washington D. C. office, American a division of North American Aviation, Inc., Denver, Calif.

Honors and Elections

Dr. John T. Kellert, president of the new Institute of Technology, has been named chairman of the board of trustees of the Air University at Maxwell Air Force Base, Ala. The board whose membership is at the invitation of Gen. Nathan F. Jones, acting Chief of Staff is selected to evaluate aircraft manufacturing and business of the Air Force, a professional education system.

Richard H. Bennett, retired Army engineer at Douglas Aircraft Co. has been elected president of the Aircraft Electrical Society for 1971. Vice President, chief of the Electrical Design Section of Douglas, vice president.

Peter Swan, test pilot for The Fawcett Cannon Co., Ltd., has received the Silver Trophy which is awarded annually to the pilot who makes the most extensive use of instruments of the prototypes of aircraft by hand in a test.

Wing Firing, major engine test, aircraft, production systems of Sperry Corp. was elected president of American Astronautical Society for 1971.

Changes

Yvonne DeLoe, factory manager, Converter a Division of General Dynamics Corp., Fort Worth, Texas. Gen. S. Goss, on crack Mr. DeLoe in development manager. E. M. Finkelm, assistant chief engineers, flight test, Converter a Division of General Dynamics Corp., San Diego, Calif. Van C. C. Wilkoff and Kenneth C. Gough have been added to the Air Force research and development staff. K. M. Campbell succeeded Mr. Wilkoff as manager of Converter's Dayton Ohio office.

John C. Howe, district sales manager, Dayton, Ohio office, Light Military Electronics Equipment Dept., General Electric Co., Utah, N. Y.

INDUSTRY OBSERVER

Reynolds Aircraft Corp.'s F-101 program includes design projections for seven versions of first-line fighter, including, design, development, test, low altitude, low ground attack and high altitude. The aircraft, which is powered by a J65W-37A, can carry three large external stores, one under the belly and one under each wing.

Three prototypes of General's B-56 supersonic bomber are now being flight tested from the company's Fort Worth Division. Top speed of the aircraft is approximately Mach 1.7.

Third-stage rocket motor of Project Vanguard developed by General Central Rocket Co. completed prequalification tests. Motor is being static tested by Glenn L. Martin Co., prime contractor for Vanguard, at USAF Mach Test Center, Patuxent, AFB, Md.

Bell Helicopter Corp. has installed a new two-bladed rotor system on its second XV-3 and will test it as a possible alternate to the conventional's present three-bladed system. The installation will be shipped to National Advisory Committee for Aeronautics' Ames Laboratory at Palo Alto, Calif., for wind-tunnel testing.

Boeing and General are considering the Continental T51 680 hp. turbine engine for small turbo-prop aircraft; aircraft projects both companies now have in the drawing boards.

General's Pomona, Calif., mobile facility is considering the redesign of the guidance installation in case of Navy's Torpedo surface-to-air missile to eliminate substandard condition obtained with conventional systems.

Kellert will replace the rotary rocket engines on its KH-11 ocean map helicopter with cold-gas type powerplants utilizing hydrogen as a motor gas. Pressure advantages—increased flight duration and increased speed.

Canter-Wright Corp. is looking for new plant acquisitions, particularly equipment companies, with an annual sales volume, or immediate potential, of at least \$5 million.

Stanford Research Institute is conducting research on sled friction for the Naval Research Test System, Glenn Lake, Calif. Sled friction of riggers on rails of high-speed aircraft sled tracks is one of the basic problems in sled work.

Three patterns of the burning of stainless steel inserts in sled supports used in the Common-USAF sea cruise research sled at USAF Flight Test Center, Edwards AFB, Calif., indicate that the sled actually runs on a carbon layer of carbon, which acts as a liquid lubricant between the slipper and track ribs. Ribbed extended more than one inch below the slipper, but disappeared almost completely when the sled entered insulated wind-tunnel on a portion of the track.

Work is scheduled to begin next month on the construction of technical facilities at Camp Cook, Calif., in connection with rehabilitation of the air for USAF's ballistic missile training program.

Unusual degree of dual-industry-industry cooperation is evidenced in the three-way effort to solve the tough airborne proximity warning collision avoidance problem. USAF's Wright Air Development Center, which was soon launch a program at Bendix Radio, is working closely with the Air Transport Union, and various manufacturers are fresh exchanging the results of their studies of the problem, releasing data which usually is considered proprietary.

Armstrong-Corbin Corp. has completed preliminary planning study for damage potential test, recently constructed at USAF Ammunition Center, Eglin AFB, Fla. (AW Aug. 6 p. 11). Chicago Machine Laboratories is participating in a continuing test vehicle development program for the track.



HOW THE SILICONES MAN HELPED...

Build a Gyro for Straight Shooting!

Accuracy that could let a fly from a swimming roller coaster... is rugged that it can be used to drive nails without impairing its operation. That's the "impossible" fine control gyro built by Minneapolis Honeywell, Acrometrol Division, known as the HBG-3 (Honeywell Integrating Gyro), lightweight and small enough to hold in the palm of your hand, it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a viscous fluid under wide limits of temperature and pressure, such can be as less than perfect. What material was used? "G" rings of Union Carbide Silicone Rubber.

Fabricated by Maxson Products Company, Racine, Wisconsin, these "G" rings were tested from -65 to +280 deg. F., at simulated pressures from ground level to operational altitudes.

Under such rigid tests, Union Carbide Silicone Rubber showed outstanding setting qualities and resistance to compression set.

This is another example of how the Union Carbide Silicones Man has helped solve an "impossible" problem. A booklet—"Look to Union Carbide for Silicones"—describes silicone rubber and many other silicone products. Write Dept. AW-44 to: Union Carbide Division, Union Carbide and Carbon Corporation, 30 East 52nd Street, New York 17, N. Y.



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In Canada: Look to Pyrochem Company, Division of Union Carbide Canada Limited, Toronto.

Threat to NACA

National Advisory Committee for Aeronautics' long-standing program of contracting with universities and other institutions for research is meeting strong opposition in Congress.

The House, on the recommendations of Rep. Albert Thomas (D., Tex.), has voted to ban the program. Not only NACA's request for \$770,000 for outside contracting during Fiscal 1955 turned down but the authority for outside contracting was withdrawn. Thomas leads the House Appropriations Subcommittee in charge of the NACA budget.

The matter is now pending before the Senate Appropriations Subcommittee headed by Sen. Warren Magnuson (D., Wash.), who favors the program to stimulate college students, professors and scientific personnel with NACA activities.

More General USAF Shifts

Major personnel USAF shifts that began with the deaths of Gen. Nathan F. Twining to be chairman of the Joint Chiefs of Staff are continuing. Major job still open is commander of Strategic Air Command (left vacant by promotion of Gen. Curtis LeMay to USAF vice chief of staff). Lt. Gen. Frank P. Row, a close associate of Gen. Twining, is expected to get the post although other strong candidates include Lt. Gen. Kenneth O'Donnell and Lt. Gen. Thomas Power, both of whom have had extensive SAC experience under Gen. LeMay's command. Other shifts include Brig. Gen. Arno Lichtenhan to succeed Brig. Gen. Andrew Kinnear as USAF intelligence chief; Lt. Gen. William Turner to succeed Lt. Gen. Joseph Smith as commander of Military Air Transport Service; and Lt. Gen. Francis Griswold to become commander of the Tactical Air Command.

No Funds For OSI

The House of Representatives has refused to authorize postage or new funds for the Office of Scientific Information, in an effort to block the controversial agency. Likened to the House of Representatives, the OSI is expected to be the last of its kind. The action was taken in connection with the Fiscal 1955 Commerce Department budget, which becomes effective on July 1. Secretary of Commerce Sinclair Weeks had asked approval of \$49,330 for its operations in fiscal 1955.

Rep. John Moss (D., Calif.), chairman of the House Government Information Subcommittee, which recommended abolition of OSI a year ago, applauded the House's action and declared that "the OSI has no other shot of what it is supposed to do here it is to go ahead doing it and, most important, why." Complaints against OSI's membership statistics, Moss noted, came not only from the press and scholars "but also from military and intelligence experts within the government."

Railroad Anti-Trust Suit

Aeromex Transport Air has filed a \$45 million, triple-damage antitrust suit against 41 members of alleged monopolizing commercial transportation of air lines. Aeromex, the group charged the members with "predatory rate practices," an allegedly offering below-cost and transportation to official military traffic and claimed

in an affidavit accompanying the complaint that unless the injunction is granted, the supplementary owner who try will be "defunct."

The group accused the airlines of reducing rates from 10 to 100% below first class fares when competing in bulk for traffic with an overseas. It also charged that when a particular group movement is not high to bring a bid from supplemental air services, the airlines generally charge the military establishment the maximum price allowable.

Fair carrier joined ACTA in the suit—Aeromex Corp. of Seattle, Laevis in Mexico, Regia Cargo Airlines, S. S. W., Inc. and Air Cargo Express.

Intelligence Information

Senate Appropriations Committee is expected to study the basis for U. S. intelligence information on Russian military capabilities before approving defense or foreign aid appropriations. It has been requested to do so by one of the committee's members, Sen. Allen Ellender (D., La.), in a report issued upon Ellender's trip to Russia over the past two years. Ellender's position is that U. S. intelligence over estimates Russian strength.

At a committee session, after noting the down grading of Russian strategic air power by U. S. intelligence over the past year, Ellender commented that "I believe we are getting less intelligence information... I think that ought to be looked into before we proceed to expend as we are and spend all the money we are."

Dr. James Doolittle, chairman of National Advisory Committee for Aeronautics, replied: "We would like to have more accurate information. But I would not write off the information what we have as being totally incorrect."

Supplemental Proposals

Proposals for two new types of supplemental scheduled air service are encountering vigorous opposition.

•**Shorter G. Tipton**, Air Transport Association president, objected that Civil Aeronautics Board's plan to award "supplemental" certificates with limited frequency upon business to schedule air carriers would produce "confusing," in instances, before the Senate Commerce Committee Subcommittee headed by Sen. A. S. Mike Mansfield (D. Utah).

•**Capt. Eddie Rickenbacker**, Eastern Air Lines' chairman of the board, predicted that "this committee" promising scheduled airlines to shift operations to handle lesser seasonal loads "would single out a word band with of gyro, as certain during 'war weather traffic'." Rickenbacker's protest was contained in a letter to Sen. George Stettin (D., Pa.), a member of the subcommittee who suggested this type certificate to CAB.

Air Coach Transport Air and Independent Airlines Air Transport Assn. lobbied in support of the CAB proposal for limited certificates. Tipton stated that with authority for limited certificates, CAB could reward the carriers at local airports, base, helicopter operators, and all-terrain carriers, limiting their dependency of operation and type of equipment.

Rickenbacker told Stettin that his suggestion of "double certification"—particularly to handle heavy "Florida winter traffic"—has already had serious repercussions.

—Washington staff



McDonnell F-101B Makes First Flight

McDonnell F-101B became the all-weather version of the expensive F-101 made its first flight at Lambert-St. Louis Municipal Airport. Entered by Pratt & Whitney J75 engines, F-101B is designed to achieve high rate of climb and to operate at extreme altitudes. Second version is a radio observer. McDonnell and additional USAF orders had been received for F-101B, one of three versions of Phantom series.



that each crew member will spend in the atomic phase allows a lighter crew complement to be used in the design. Lower shielding weight and higher performance are then possible.

Nevertheless reduction has both immediate (within 30 days) and long range effects. There are five effects which are considered dangerous on an atomic aircraft:

- Degradation of performance.
- Increase of exhaust.
- Increase of fuel consumption.
- Shortening of life span.
- Greater maintenance.

First three are immediate effects and require a definite threshold to occur. Radiation on the atomic airplane will be kept well below this threshold level, thereby preventing these effects.

The last two items are the result of the total radiation absorption experienced over a lifetime. They can occur but are reduced to zero.

National Academy of Sciences and the Bureau of Standards recommended a maximum total absorption of approximately 100 R/MT at age 40. If this level is achieved the effect of radiation on shortening the atomic reactor's life will be less than for other conventional bombs. Predicted life span of a unit here is 10 to 12 years less than the average.

New Dual Ignition Installed in J79s

Barbours, Calif.—New dual ignition system is being installed on General Electric J79 engines which power Lockheed Avonair Corp.'s supersonic F-104A Starfighter.

General Electric is handling the engine improvement program, which will require approximately two weeks.

Installation of the new ignition devices forced a temporary suspension of F-104A flight operations at Palm Dale. As soon as improved engines can be installed in the Starfighters, the flight program will be accelerated to meet its previous schedule, according to Lockheed officials.

Last test, USAF acceptance test pilot R. C. Bowser was killed while attempting a deadstick landing after the J79 flamed out during an F-104A acceptance test flight. Last week, another USAF pilot, E. C. Hunt, bled out of a F-104A after flame-out during a test flight. Early in the NF-104 test program, Lockheed test pilot A. W. Lauer successfully landed a prototype after flame-out of the Curtiss Wright J67 engine used in the NF-104 Starfighter model.

All fireworks occurred over the Astor Valley test flight area.



VERTOL COMMERCIAL HELICOPTER demonstrates last week at Philadelphia with 15 passengers in cabin version. Vert model 44 aircraft displayed here. French markings (top left above). Cabin features soundproofing, carry-on baggage rack, door-locked loading door.

Vertol Commercial H-21 Certificated

Philadelphia—Tandem Vertol Model 44 commercial helicopter formally received its Civil Aeronautics Administration type certificate here last week after public demonstrations at Philadelphia International Airport. Model 44 is a version of the military H-21 Work Horse (AWA 4-1, p. 30).

Vertol is offering the conversion, an eight-passenger helicopter in three models for instance, 7915 delivery. Base price of the 15-passenger model is \$250,000. Another version, designed for military passenger-cargo use, will sell for \$275,000 as base price and a third, executive version will be custom appointed for its buyers with price dependent on the equipment.

Model 44s demonstrated at International Airport are the 148 15-passenger version. The units are being delivered to the French government for constant military VIP transport use. Their design is distinctive brown and gold livery on the units' large door, pale carpeting on the floor.

Cabin is soundproofed for some level comparable to current fixed-wing transport.

Model 44 features oval windows, door-locked main cabin door on left side, carry-on baggage rack plus one cargo hold for checked baggage. Seats fold against the walls for full or partial conversion to cargo configuration.

Cabin is 20 ft. long, 7 ft. 6 in. high, 5 ft. 6 in. wide. Second door at front of the cabin on the right side is used for main cargo door.

Model 44's useful load is 5,145 lb. It cruises at 130 mph, and range is 160 mi. with standard fuel system.

Vertol estimates the operating cost of the 15-passenger model at 114 cents per seat-mile with an 800 lb. maximum useful load and based on 100 mi. block operation.

At same block distance but with a 2,800-lb. normal utilization, seat-mile cost will be slightly more than zero cents Vertol says.

Utility version, Model 44A, is designed to carry 19 passengers or cargo with a 6,000-lb. capacity.

Executive version is Model 44C. Empty weight of the base aircraft is 8,555 lb. Emergency landing gear, in Vertol's figures, would add 215 lb. to



FORWARD CARGO DOOR is feature of Model 44. Cabin accommodates 600 cu. ft. of cargo. It can be loaded by an external cargo sling. Delivery of new unit costs about \$275,000. Airlines price will be about \$275,000.

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Vacuum melted alloys, as developed by the Union Metals Division of Kellogg-Blaylock, provide extreme cleanliness, maximum chemical uniformity. They are superalloys, developed to withstand stresses and temperatures generated at supersonic speeds.

The Utica Metals Division expands still further Kelley-Hayes' capabilities in the manufacture of superalloy metal products for industry.
Kelley-Hayes Co., General offices: Detroit 32, Michigan.

KELSEY-HAYES

Aviation Week surveys progress, design changes being made in U. S. commercial turbine transports.

Los Angeles—U.S. turbine transport manufacturers are pouring men and money into meeting deadlines for first flights, certification and customer deliveries of turboprop and turboprop-derivatives. An Associated Press series of pages this time for shows that

• Douglas has completed 95% of DC-8 engineering with close to 100% done on the airplane systems 65% done. You obtained 5 519 drawings of the plane out the system. Working is well advanced, so is the subcontractor progress. New manufacturing facilities at Long Beach for DC-8 final assembly are 90% finished, with some of the L-1011-90-17 already in operation. First flight target date is now March, 1975, with the first new airplanes participating in the Civil Aeronautics Administration type certification program. Takeovers of the line number by Boeing.

• **Lockheed**, with various difficulties, has virtually completed engineering on its Helios turboprop transport, has 75% of its tooling built, is well into the fabrication of the first airplane, has parts of the second in the works and has more than 15% of the necessary basic research completed.

• **Omniac** engineering has reached drawing release stage for the 300 mhd jet transport despite the aircraft's late entry into the field. Tooling is under construction, hand made parts are being tested, and production assembly is scheduled to begin soon.

• **Finchfield**, with operations geared to production of an already designed and constructed aircraft, has 60% of its tooling done for the B-27 Freighter technology, has fabrication under way on the first airplane and sections and wings.

• **Boeing** has completed engineering on its 707-120jet transport except for tailing customer service furnishing its equipment. Tooling is completed for the 707-110 and 220 and is well along for the larger 320 intermediate-range model. Fabrication of the first aircraft is well under way, and parts of the second are being formed for subassembly. Some flight testing has been accomplished with the 707 prototype, especially in systems and automatic flight controls.

Start of the turbine transport program marked the entry of two engine manufacturers Allison and General Electric, into the commercial field. Both are using the turbine boiler as

Report beginning on this page on the progress of U.S. aircraft manufacturers toward the production of three jet-powered turbine-powered transports was gathered and prepared by Richard Swenson and Irving Stone of Aviation Week's Los Angeles bureau.

technical support in development and operational testing programs. Pratt & Whitney already is well established with major orders on hand for country club versions of the J57 and J75 powerplant for Douglas DC-8s and Boeing 707s.

Allison already has installed two Lockheed Electric power packages in its converted Comair-Lear transport. Packages are slated next to take the Electric aircraft along with the 701-011 turboprop engine and Avionics/controls 006 assembler.

Lockheed began test flights March 1 on an Electra nacelle installed in the right outboard position of its flying test bed, Constellation No. 1091. In addition, the company will have a Super G Constellation flying each in jux with four Electra crew airplanes.

Although the Allison 561-D13 is a commercial adaptation of the military T-55 which powers the Lockheed C-119 tanker helicopter transport and will have seen extensive service before the first kinetic delivery, the additional flight test program has been established in order to have more than 500,000 flight hours on the engine by the time

it is not a commercial enterprise

Supporting Concept, continues ground testing is now in progress at General Electric's Evendale plant on the CJ-805's commercial version of the J79. Current plans under study at San Diego, Monrovia, Convair and General Electric are giving an increasing flight experience with the J79 in Convair's USAF B-58 supersonic bomber, and the CJ-85 is currently the same power plant across all variants.

³Independently, General Electric is conducting extensive flight tests with the J79 in the F-104, F-100 and F-4D at Edwards AFB, Calif.

Smaller modern fuel jets have been under study by Boeing and Douglas.

The Douglas pine isobutylate described the DC-5, would be a serious downs version of the DC-5. This is a patentable factor in that such equipment would be interchangeable, maintenance would be easier and a lower overall investment in space, heating and ventilation would be necessary.

Post-implants considered for use on the DC-4 include the Pratt & Whitney J51-a Navy development scheduled to go on the A-6D 1-Cougar Electric's QJ 801 and several foreign engines.

Many industry observers, however, feel that the DC-9 will not properly be used the design study stage. Thus to do, several sets of specifications for the DC-9 are in existence and power plants in the desired thrust-weight ratio are limited.

Boeing also has stressed the financial advantages of physically similar, or identical, transports for modern and dual-basis engine aircraft.

Recent has received two medals



NEW DRAWING of Lockheed Electric helicopter reveals wedge shape to conform with Army's new Sikorsky-Boeing helicopter configuration, now based on Sikorsky Configuration

EXTENSION LETTER April 14, 1962

short-haul jetliners, the 717 and 727. The 717 will be the same price as the 787 but will have lighter internal and lower gross weight. The 727 will be smaller, but a lower gross weight. Both are in the design study stage and, like the DC-9, probably will not be built. Possibilities such as the J51, J79, and possibly the Bristol Chaparral, are still being investigated.

Douglas

To build the DC-8, Douglas has constructed two new buildings at its Long Beach plant, incorporating newly completed design for alterations, as well as at Santa Monica, where other transport aircraft are built and all transport engineering is accomplished. Fabrication on the first airplane is under way, first assembly work on the first section having started on Feb. 25, wing span assembly beginning in March and main fuselage work beginning on April 1. A virtual shell has been put on DC-8s since assembly at the area, Long Beach facility.

Parts for the DC-8 are being fabricated at several Douglas Southern California plants and fed into assembly at Long Beach.

Subcontractor quality has started to arrive at Long Beach. Major subcontractors are Ryan, power plant, Cleveland Pneumatic Tool Co., landing gear, and American Standard Co., which is doing wing machining work.

Engineering status on the airplane shows that wing, fuselage and power plant are 99% complete; air conditioning and hydromechanical system are 98% completed; interior and electrical systems 95% done; landing gear, engine, engine compartment, debris protection on the last section of the airplane is in progress or 60% finished.

The first Long Beach facilities are already in structural design, including where subassemblies are built, and the final assembly building for the airplane, which is planned for the same use for both domestic and international models, but with different powerplants, gross weights and performance.

DC-8 Orders

Douglas now holds 120 firm orders for the DC-8 in both configurations. Customers, number of airplanes, type and engine specified are:

- **Pan American**, 21 international models with the Pratt & Whitney JT5
- **United Air Lines**, 30 domestic, 12 with JT5, 18 with the JT5, a take order with engine order
- **Norfolk Air Lines**, six domestic with JT5
- **Eastern Air Lines**, 28 domestic with JT5
- **Delta**, eight domestic, six with the JT5, two with the JT5
- **Paragon**, five international JT5

- **Trans-Canada Air Lines**, four international models with Rolls-Royce Conway JT5
- **KLM**, eight international models with JT5
- **Japan Air Lines**, four international models with JT5
- **Scandinavian Airlines System**, seven international models with JT5
- **Svenska**, five international models with JT5
- **UAF French Airline**, three international models with JT5
- **An unnamed order** for three international models with JT5.

Specification Change

Douglas has issued a new set of specifications for the DC-8 covering two changes in physical (structural) and seven performance alterations due to powerplant changes.

Physical characteristics changes from earlier specifications (AWB No. 20 1978, p. 185) are an increase in fuselage length from 148 ft, 10 in., to 154 ft, 6 in., and a reduction in landing gear compartment volume from 1,445 cu ft to 1,315 cu ft.

In performance, the Pratt & Whitney JT57 international engine formerly specified for DC-8s was the JT3C-6, with some performance figures changed. There also have been changes in the Pratt & Whitney JT54-3, the common rail version of the JT5, which have resulted in performance specification changes. The same holds true for the Rolls-Royce Conway engine type.

- **Maximum takeoff weight** has increased from 109,000 lb. to 119,000 lb.
- **Manufacturer's empty weight**, to 511,539 lb. from 514,688 lb.
- **Operating weight empty**, to 521,034 lb. from 518,726 lb.
- **Capacity payload**, space limited, to 33,670 lb. from 34,240 lb.
- **Number of passengers**, to 138 from 122.
- **Range**, statute mi. to 3,044 from 3,010.
- **Cost per airplane mile**, to \$18.18 per statute mile from \$15.44.
- **Cost per seat mile**, to 1.35 cents from 1.26 cents.

Tourist Changes

- **CAA field length required** for takeoff, maximum takeoff mt. to 3,859 ft. from 3,448 ft.
- **Range** with 6,500 lb. CAA takeoff field length, to 2,040 statute mi. from 1,850 statute mi.

Weight Changes

- **Capacity payload space limited** cost per airplane mile to \$1.80 from \$1.81.
- **Capacity payload space limited** cost per seat mile, to 1.36 cents from 1.19 cents.
- **Level flight maximum cruise thrust** at 10,000 ft. at 270,000 ft. lb. to 509

field length, to 1,700 statute mi. from 1,770.

- **For the JT5 domestic first class seat**, changes are:
 - **Capacity**, payload space limited, to 51,620 lb. from 54,240 lb.
 - **Number of passengers**, to 124 from 122.
 - **Range**, to 4,060 statute mi. from 3,910.
 - **Cost per airplane mile**, to \$1.74 per statute mile from \$1.72.
 - **Cost per seat mile**, to 1.40 cents from 1.41 cents.
 - **CAA field length required** for take off, maximum takeoff weight, to 7,100 lb. from 5,810 lb.
 - **Range** with 6,500 lb. CAA takeoff field length, to 3,470 statute mi. from 2,650.

For the domestic JT5 tourist version, weight changes are as specified, payload space limited cost per seat mile, which is now 1.21 cents as compared with 1.19 cents for the earlier specification and range with 4,500 lb. CAA takeoff field length is now 3,218 statute mi. as compared with 2,495 on former specifications.

International Changes

- **For the JT5 powered first-class international airplane**, changes are:
 - **Range**, under empty payload space limited, to 4,490 statute mi. from 4,470.
 - **Cost per airplane mile**, empty payload space limited, to \$1.84 per airplane mile from \$1.91.
 - **Cost per seat mile**, empty payload space limited, to 1.50 cents from 1.46 cents.

Range with 6,500 lb. CAA takeoff field length, to 3,078 statute mi. from 3,068.

Tourist version, JT5 international changes are an increase in capacity, payload space limited range, new 4,560 statute mi. from 4,470 statute mi., a cost per seat mile increase and empty payload space limited condition from 1.34 cents per seat mile to a new figure of 1.37 cents, a 6,500 lb. CAA takeoff field length range increase of 10 statute mi. from 2,968 to 2,979.

Conway Version Changes

- **Changes in the Conway** (a powered international first class jet plane) are:
 - **Manufacturer's empty weight**, to 517,473 lb. from 515,877 lb.
 - **Operating weight empty**, to 525,272 lb. from 523,776 lb.
 - **Capacity payload space limited** range, to 4,500 statute mi. from 4,818.
 - **Capacity payload space limited** cost per airplane mile to \$1.80 from \$1.81.
 - **Capacity payload space limited** cost per seat mile, to 1.36 cents from 1.19 cents.
 - **Level flight maximum cruise thrust** at 10,000 ft. at 270,000 ft. lb. to 509

ph 148 from 582 mph TAS

- **CAA field length required** for takeoff at maximum takeoff weight, to 3,370 ft. from 3,000 ft.
- **Range** with 6,500 lb. CAA takeoff field length to 3,330 statute mi. from 3,250.

For the tourist Conway version, capacity payload space limited cost per seat mile will decrease from 1.27 cents per seat mile to 1.25 cents per seat mile and range with 6,500 lb. CAA takeoff field length, has increased from 3,190 statute mi. to 3,218.

Lockheed

Lockheed is well along toward meeting its Electra first flight date next June 1.

Basic structural engineering is 100% planned to production and tooling, basic structural design is 99% complete, only details expected by the end of the month.

Lockheed has completed test programs in strength, windtunnel and fire testing. Still ahead are landing gear drop tests, and system environmental tests.

Lockheed, which already has signed contracts for \$125 million for materials for its own use in the Electra program, will fabricate the entire aircraft except for power packages from Electra, landing gear from Messerschmitt, wing landing and trailing edges from Fokker.

Fabrication of the first airplane, which will go to Allison Division of General Motors for additional testing of the 505-D11 powerplant and the Geniebus 685 gearbox, began last January. Mating of the first wing-beam section is scheduled for Aug. 1, which is set for Dec. 1 and first flight for 67 days later.

Wings for the first plane are already being completed; wings for the second aircraft are in final assembly. First test engineering is in assembly at Broken Hill, Calif., where a new 68,000 sq ft plant was recently completed for Electra but construction along with other unannounced operations for the turbojet Electra.

Major Design Changes

- **Major differences** between early and present Electra are:
 - **Tail section** has been redesigned for greater strength.
 - **Enter assembly** supported in weight reduction program. Reductions included shortened tailpipes on all four engines.
 - **Maximum gross weight** for the airplane has increased from 119,000 lb. to 117,000 lb. Maximum takeoff payload has been increased by 2,000 lb. to a present total of 28,648 lb.
 - **Maximum landing** gross weight, controlling factor for using an airport in the short runway field classification

without reflecting at every stop, a 95-616 lb.

Airport restrictions to be introduced on the Electra include:

- **"Living room"** interior, in which passenger seating is influenced by, compartments containing seats distributed around tables with individual table lamps, arranged in an aisle similar to a living room. Proper attention of the compartments results in no loss in the number of passengers the plane can carry. The new atmosphere affects it sufficiently for American Airlines for it to accept the six-month delivery delay, it will save. Because of this, Eastern Air Lines will be the first to place Electra in service, although American placed its first order.

• **Faster baggage handling** procedure, in which containers disintegrate luggage is put into a bin at the check-in counter. The bin is loaded and unloaded on the airplane automatically, and a greater number of passengers can be loaded as baggage is provided for their baggage provisions with smaller bins.

A new baggage handling system was the first manufacturer's came to help reduce delays attendant to today's baggage systems which is practically the same as in the DC-8. It will be used as an airline speed contribution to go with higher takeoff-transport speeds.

The Electra will use an international starting system developed by the Allison Division of General Corp. The system is designed to be built for starting one engine but holds at start the other three powerplants. Better change in 20 min.

Ground Handling

In ground handling and equipment, Lockheed has developed a new wheel and tire clip, the wheel into a new swiveling condition when towing pressure is applied and returns it to its normal condition when the towing pressure ceases.

The Electra will need auxiliary power units of greater output than those used for today's aircraft.

For customer service, Lockheed already has installed a service program, with a spare control apparatus attached to each Electra customer to help plan spare ordering and stock holding and to coordinate with the factory to ensure that adequate spare parts always are available.

Announced Electra buying is 171 airplanes, worth \$144 million, with 13 for Delta and four for Trans World. The first of 40 on order. Other airlines, their orders and first delivery dates are: American, 35, January 1979; National, 25, April 1979; Braniff, five, May 1979; Western, six, June 1979; KLM, 11,

September, 1979, plus four others for as yet unannounced customers.

Convair

Entering the jet transport picture late, Convair Division of General Dynamics Corp. is pushing hard to make up for lost time and is making exciting progress.

With 44 of its medium-range 580 jet transports on order—30 for TWA, 10 for Delta and four for Trans World—\$5.4-A-Convair has scheduled the first delivery to TWA for November, 1979. The initial plane, also will be used for pilot training, ground handling surveys and arriving experience. Delta is scheduled to get its first 580 in January, 1980.

In September, 1968, Convair hopes to have completed the first 40 of the new medium-range jets based upon a production rate of up to 10 per month.

Engineers and testing vehicles accomplished to date indicate that Convair now has the November, 1978, not out of sight. This in turn, academic completion of flight test schedules.

880 Progress Survey

A progress survey on the 880 jet transport, powered by four General Electric G1985 engines, reveals that: • **Configuration** is finalized, based upon essentially complete wing tunnel data obtained from the National Advisory Committee for Aeronautics Langley research installation, the Southern California research installation, and the Convair plant at San Diego. • **Well over 50 million** in basic design time for the model and actual tests.

• **Approximately 90%** of design thinking is related. Engineering drawings on wing and landing structure are scheduled for release next month. This includes all bolt figures in the structural section of the fuselage, many of the new structural elements, wing and fuselage details.

• **Cost, price and engine installation** engineering is on schedule at Rocky Air Tech Corp. Rock is engineering the details under Convair's design concept and also providing the design.

• **Building** jet engineering is now being named out at Convair's Transportation Tool Co. under Convair design direction.

- **Long lead time** procurement items, such as turbine, electronic fuel and control systems, are getting engineering input on options.
- **Production** tooling for wing and landing are now being installed in the area allotted to Rock. These tools will be built at Convair's Plant 1 outside area and now completed about one month ahead of schedule. Traffic now however had to avoid clearance of plant area previously allotted to

COVERAGE



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Capital President Says Viscount Slandered by Competing Airlines

By James Dingley

New York—Capital Airlines' Viscounts have been subject to "various and scurrilous attacks" by competing airlines, Capital President J. H. Carmichael stated.

Since the first arrival of the Viscount in June of 1948, Carmichael charged, "its reputation has been subject to the most vicious and unfounded attacks on a continuing basis conducted in places that this attacker thought would do the most harm. I was thoroughly shocked and disturbed by these attacks when I first learned of them and I still am."

"I want to say here and now that neither Capital nor I as president will ever lend much to the type of person used against us. We will never employ such unethical tactics."

Carmichael and the competition, which he did not name, went so far as to have its pilots invade the Viscount's fleet personnel over their airplane's public address system.

He quoted one pilot as telling the passengers:

"Look, sharply now and you'll see us by just the Viscounts. If we want dependable service, stay clear of Viscounts."

Viscount Defended

Carmichael told of the attacks during a luncheon at the Society of Automotive Engineers' National Aeronautics Meeting and made a defense of the telephone airplane manufactured by Vickers Armstrong, Ltd.

Capital now has 60 of the machine ranging 44 passenger airplanes in operation and 16 more on order. Carmichael said, "Business men have been saving for the 15 and delivery is scheduled to start soon."

The company last \$2.5 million last year, but Carmichael said this Viscount equaled a profit.

"The Viscount earned Capital a 5 per cent return," he said. "The Viscount is a good airplane and it's not going to go broke operating it. We're DC-3s, DC-4s and Constellations, and we didn't make a profit on any airplane but the Viscount."

Ten times as one of the major companies involved in the Viscount movement. Carmichael said, "Viscounts into the Viscount itself was less complicated and required less time than that into the DC-4s and Constellations."

"That's another feature that people don't realize," Carmichael said. "Our pilots moving into the Viscount re-

quired pilots to move up into other airplanes."

Altogether the three machines involved 1,595 flight personnel, 611 of them on Viscounts. Personnel trained for maintenance numbered 865.

Carmichael and the Viscount program wasn't particularly difficult, that the telephone is a relatively simple power production system and the major thing the pilots had to learn and master, indicated, was its fuel area system.

Viscount Problems

Reaction of pilots to the Viscount has been favorable, Carmichael said. "I would have never flown anything like better. The airplane is maneuverable, its response is instantaneous. The airplane looks even smaller than it is, and there are no steps to climb. You just get out and take off."

The airline president admitted that the Viscount had its problems. It was found that the cabin conditioning system was inadequate; it wouldn't cool sufficiently on the ground as Viscounts are kept in the winter. Instead, he was discussing behind the problem.

Brake troubles were Capital's own fault, he said. The original steel being run through to copper to save weight, but the copper heated up and the steel was weakened.

Because of the B-24 Viscount crash in England recently, the Capital Viscounts were withdrawn from service to replace the attacker's faults. Car checked and there was no aerial grounding, and the program was completed in 72 hours.

And despite the rumors," Carmichael said, "we have had no trouble with the Viscount. It's not the fault of the airplane when the pilot lands with the landing gear retracted."

Spor Criticism

Carmichael said criticism of the Viscount has centered on its single gear wing construction, that it was a first-class airplane and had insufficient noise.

Defending the single gear, Carmichael said these are a lot of theories on such construction and no one has yet proved anything wrong with it.

"I notice that the competitors' attacks in the past and all show goods were found in his own airplanes' own spots."

Carmichael blamed some of the Capital's weather flying problems last winter on the high insurance weather requirements voluntarily agreed on

all pilots newly checked out in the aircraft. This consisted of a 100 hr minimum in the aircraft the pilot was flying.

Average handler with the equipment could have accepted," Carmichael said. "It has been over 1,500 pilots operating under high insurance requirements via air going to spend a lot of time on the ground, and so you know last winter was one of the toughest we've experienced. But now we've got our weather of flying under our belt. Weather is next year. We'll have the Big Four airplanes looking down on us before all winter."

Carmichael and the Viscount were the best possible argument for Capital, whose largest route is 1,000 mi.

"We don't contend that at the best altitudes we're as fast as the DC-3, but we're going to be better because we're closer to operate and more maneuverable."

In Europe, he said, B-24s are flying Viscounts daily on routes 1,000 mi or better, but there is too much traffic and congestion to do it in the U.S.

"We're doing it at altitudes of 600 mi and we can do 750 mi very nicely. We didn't lose them to operate any longer than that. We'd put in some land at Pittsburgh and what else can be done in a week in New York."

Carmichael told of a hotel who complained of being forced to exchange his hotel from Capital to another airline for a Washington to Chicago flight because the Capital airplane wouldn't fit in the prevailing weather.

"We turned 44 passengers over to the opposition on that flight," Carmichael said. "and we were not of great help in the time. My friend he was able to take them. They had back all, few over Chicago for new buses and flies loaded at Tulsa."

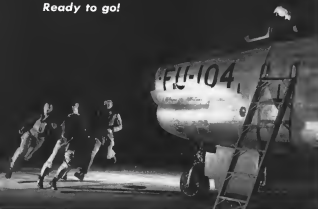
TWA Cuts Are Begun As Burgess Promises

New York—Stinson-made cuts in Trans World Airlines personnel have begun under a tightening up program authorized by Captain L. H. Hargrave, the carrier's new president. Burgess told Americans where that or more, in 1948, TWA's people might be reduced temporarily to being about a more balanced work strength (AW Feb. 4, p. 41).

Reductions so far have amounted to less than half of that percentage, Burgess Wertz has learned. Between 500 and 1,000 employees will be affected in the next few months, he said, but most will end by the middle of this month. TWA's personnel total is about 20,000.

Cuts have been made in TWA's "housekeeping" units. Little or no reduction is expected in maintenance

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GENERAL ELECTRIC



personnel has been made as it played the airline's expected delivery of new equipment, and the approaching summer high traffic season will call for some expansion of operating staff here.

Service limitations within the airline are indicated in the home-lying category, which has felt the heat of the core. For example, TWA's scheduled Atlanta department, which formerly consisted of the Atlanta-Central and Western regions, has been divided into two units, with the Central region eliminated.

Any further cuts are unlikely until after the peak season.

SHORTLINES

► **Middle East Airlines**, an affiliate of British Overseas Airways Corp., will integrate two new services and increase flight frequencies on three established routes in features of its summer flight schedule. The new routes-Boston-Rome-London, Beirut-Island-Vancouver-Frankfurt, Beirut-Bahia-Delhi (via San Galle), and Beirut-Moscow Zurich-Pan. Flights between Beirut and Cairo and Beirut-Khartoum will be increased from three to five; the Beirut-Rapido-Tel Aviv flights from one to two.

► **United Air Lines** and **Qatar Airways** have agreed an interim agreement providing each carrier to use a single ticket or schedule for passengers in cargo on the other airline. United now has a total of 164 airside agreements.

► **International Civil Aviation Organization** has transferred its North American and Caribbean regional office from Montreal to Mexico City in order to put the office closer to the states it serves. The region covers Canada, the U. S., Mexico, the Dominican Republic, El Salvador, Cuba, Central America, Honduras and Nicaragua.

► **Swissair** will begin one-stop flights from New York to Lisbon on May 4. The airline will offer two flights a week in DC-7C aircraft. Flights will connect en route to Geneva and Zurich. Swissair will be the first European carrier to offer service between the U. S. and Lisbon. The service will be part of Swissair's summer schedule, which also features one-stop flights from New York to Cologne/Bonn and Stockholm and others routed via Shannon, Ireland.

► **United Air Lines** has added special service for babies on all flights with a choice of four cribs, five cribs, double, cradle and crib.

AIRLINE OBSERVER

► **Civil Aeronautics Board** is forecasting a sharp rise in domestic truckline, transoceanic and transpacific operations for the first time in its history. Industry estimates for 1973 are confined to 325 million for 11 local service carriers, 34 million for three helicopter airlines, 54 million for eight carriers among Alaska, \$113,000 for two airlines operating within Hawaii and 51.7 million for Hawaiian and Pacific Latin American services. The Aeronautics Board's previous annual estimate of 57.5 million for 1971 has been cut to \$1.5 million, and the airline's annual of 55.5 million originally estimated for 1973 has been eliminated.

► **Aviation News** has stated that "boom boom" as viewed by public, but that such a boom, as well as actual attempts at destruction of a aircraft, would bring in Federal law enforcement agencies. Latest in a series of such notes was received by Southern Airways.

► **Majority** of air cargo traffic control centers and tower air, now operating on at least a 16-hour week because of the shortage of trained controllers. Civil Aeronautics Board says that, in some instances, controllers are working 60 to 70 days without a day off.

► **Trans-Canada Air Lines** will reduce fares on its Canadian routes when there are no competing airlines. The carrier also wants to reduce its fares on its routes to the United States and Mexico. The airline is now in the process of reducing its fares on its routes to the U. S. with routes from Montreal to Boston, Winnipeg to Minneapolis and Vancouver to San Francisco.

► **International Civil Aviation Organization** is calling for an agreement on air traffic control and navigation facilities in Central and South America. The group has labeled the deficiency "the largest gap in the world-wide system of flight information" and attributes lack of sufficient trained personnel in government service as the chief cause of the problem.

► **Air Traffic Controller's Assn.** has been granted permission by the CAB to participate in all accident investigations involving air traffic control.

► **Air Line Pilots Assn.** reports that 17 pilots living commercial airlines in over 60 years of age. ALPA president Clarence Somers told the Senate Commerce Committee that "in no transport, airline unit of paid pilot, even an airplane, more than during its early years, the pilots are the most experienced and the most experienced pilots are the most experienced pilots."

► **Assessment** of airlines to cover regulatory costs of the CAB is rate making and scale certification was suggested again in recent hearings of the House Appropriations Committee. M. C. McHugh, CAB Chairman, testified that leaving all charges against individual carriers as applicants before the Board had been studied as a means of reducing regulatory costs. Study was suggested, however, in compliance with a request from the Senate Interstate and Foreign Commerce Committee pending an investigation to determine whether such a plan would require statutory authority.

► **Civil Aeronautics Administration** is devoting 15% of its engineering staff to air transport and related problems.

► **Civil Aeronautics Board** is authorized only five appropriations in its 125 personnel complement. This includes personnel on the CAB, associate general counsel at GS-15, director of the Bureau of Air Operations at GS-17, associate director of the Bureau of Air Operations at GS-15 and executive assistant to the chairman at GS-16. Board Chairman James Duffin told a House appropriations subcommittee that he believed the CAB is the most independent regulatory agency within the federal government.

► **Aeronautics** of Mexico purchased two Boeing 707s for July or August delivery. Aeronautics expects to get a Mexico City New York route, where it will operate the 707s and DC-10s. The airline now operates Boeing 747s and Douglas DC-8s and DC-10s in its Central American routes.

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Airline Traffic—February 1957

	Domestic Passenger	Domestic Freighter Tons	Load Factor Per Cent	U S Mails	Express	Freight	Total Revenue Per Mile	Per Cost Revenue to Available Tons-Miles
DOMESTIC TRAFFIC								
American	214,430	240,157	88.1	1,331,385	701,747	5,491,447	60,892,197	57.1
Boeing	142,424	20,910	88.3	337,133	180,603	207,121	6,377,213	49.9
Capital	143,474	14,400	86.1	361,463	161,474	307,013	7,240,340	44.3
Continental	32,514	17,344	87.3	67,363	31,371	54,770	2,911,807	45.1
Delta	183,113	19,399	79.76	330,919	239,172	348,112	16,708,919	36.73
Eastern	598,111	197,418	90.88	837,447	884,143	1,900,114	36,867,163	42.68
Northwest	137,308	129,138	88.7	233,419	147,108	1,144,108	17,918,308	44.4
Northwest	28,718	9,542	60.7	11,182	14,174	44,077	1,871,881	40.2
Northwest	93,805	52,544	49.19	317,158	154,103	551,143	6,867,849	44.6
Trans World	183,099	311,171	10.3	971,947	863,818	1,600,115	29,837,454	46.6
United	485,348	281,307	89.84	2,141,738	861,474	2,813,738	36,561,508	35.17
Western	76,547	45,784	49.5	356,410	41,101	141,191	4,943,621	39.5
INTERNATIONAL								
American	18,450	9,181	75.4	10,176	508	190,447	1,368,453	74.9
Boeing	2,811	3,527	31.3	24,071	43,410	773,195	773,195	34.2
Continental	18,431	1,480	84.48	1,377	3,430	140,716	41,116	61.16
Delta	3,424	2,514	82.15	4,074	43,074	771,390	771,390	39.57
Eastern	20,740	27,440	48.76	83,119	79,182	3,176,793	3,176,793	39.77
National	6,416	6,216	41.9	9,437	3,167	24,110	476,476	41.1
Northwest	6,747	14,561	48.8	931,073	19,172	571,151	5,918,794	41.27
Trans American	3,843	3,421	89.1	38,380	136,416	811,478	811,478	38.9
Alaska	52,410	24,764	82.8	1,807,179	176,800	10,497,110	10,497,110	39.7
Pacific	19,241	40,276	71.7	104,420	1,248,712	9,086,482	9,086,482	42.9
Latin America	14,291	16,321	49.5	309,158	3,076,479	19,440,440	19,440,440	42.7
Panama	11,094	14,811	49.7	33,163	100,115	2,108,116	2,108,116	42.9
Trans World	11,310	28,792	34.8	708,474	720,390	4,363,807	4,363,807	46.6
United	6,240	16,070	45.67	77,430	63,444	1,747,447	1,747,447	39.46
LOCAL SERVICE								
Allegany	26,134	6,429	47.7	2,341	16,420	4,240	409,484	39.3
Bozeman	10,891	2,469	48.1	4,107	1,074	4,343	396,772	47.9
Central	6,433	1,207	28.4	3,787	2,342	4,343	444,444	42.1
Frontier	6,434	2,469	48.1	4,107	1,074	4,343	444,444	42.1
Lake Umbagog	10,891	1,469	43.4	2,341	18,112	173,230	173,230	39.2
Metropolitan	27,270	2,114	69.4	4,879	11,024	13,543	317,310	40.1
North Central	42,861	1,901	43.7	18,691	28,119	4,343	444,444	42.1
Omaha	31,180	1,469	33.9	8,105	13,347	173,230	173,230	39.2
Pittsburgh	31,281	1,864	41.4	12,274	8,430	4,343	444,444	42.1
Seattle	14,283	1,864	40.7	8,105	8,443	348,443	348,443	40.3
Southwest	31,493	4,469	39.9	1,145	2,817	5,819	403,833	40.4
Trans-Pacific	17,092	1,216	29.9	12,249	7,467	17,212	444,444	42.1
West Coast	16,800	1,074	42.41	3,840	1,477	3,793	375,375	42.74
MAIL SERVICE								
Bozeman	31,276	4,203	34.3	2,807	10,101	41,401	41,401	45.3
Trans-Pacific								
OVERSEAS TRAFFIC								
American	9,008	21,791	99.9	80,768	31,213	355,491	355,491	99.9
Boeing	772	3,119	148.8	77,744	1,074	3,074,117	3,074,117	99.9
Continental	3,400	10,494	19.47	77,744	99,414	1,074,117	1,074,117	99.9
MAIL SERVICE								
Chicago-Milwaukee	1,145	18.3	39.9	2,341	5	4,114.3	4,114.3	35.1
San Francisco-Albany	3,440	42	45.3	3,761	1,104	14,104	14,104	47.3
New York-Albany	2,172	39	39.4	1,107	84	8,104	8,104	34.1
ALASKA								
Alaska Airlines	343	319	16.9	17,044	193,112	971,499	971,499	33.4
Alaska Coastal	8,140	189	60.1	2,080	2,074	36,440	36,440	43.8
Coastal	848	140	41.6	2,779	16,174	41,411	41,411	44.0
Delta	2,817	180	41.6	1,219	1,219	16,174	16,174	47.4
Pacific Northwest	2,144	6,873	30.3	41,278	161,158	794,440	794,440	49.6

*Not available

**Not transferred to full.

Compiled by AIRLINE WEEK from data reports to the Civil Aeronautics Board.

MORE ABOUT BRISTOL'S "WHISPERING GIANT"

Noise-level tests prove that the Britannia WHISPERS!



World's largest, fastest, quietest turboprop airliner reduces noise levels to a new low

Official noise-level tests at a large international airport have underlined the instant comfort of Bristol's Whispering Giant. With a ground noise-level of 80 decibels when taking off, the Britannia was 50 decibels quieter than jet transport flying today, 20-25 decibels quieter than current five-engine airliners . . . and quieter even than two-engine airliners.

The Britannia carries up to 133 passengers in amazingly

low operating costs. She is the world's most versatile airliner because she meets the maximum bar machine standards of efficiency and economy on an extremely wide variety of stage-lengths . . . from 5,500 right down to 200 miles.

Powered by four 4120 h.p. Bristol Proteus turboprop engines, the 175,000-lb Britannia cranks at a guaranteed 400 m.p.h. with all the smoothness and whispering luxury associated with turboprop flight.

The Britannia has been more thoroughly pre-operationally tested than any airline ever before. Her structure has undergone over 54,000 simulated flying hours in a pressure tank . . . while her engines have been proved in more than 75,000 flying and beach hours.

She is the latest product of a company long renowned for progressive ability, achievement and reliability in aviation technology.

The Britannia has met with worldwide recognition and demand. She is now in commercial service with British Overseas Airways Corporation and has also been ordered by Northwest Airlines, Canadian Pacific Airlines, El Al Israel Airlines, Hunting-Clon Air Transport, The Royal Air Force and The British Ministry of Supply.

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MISSILE ENGINEERING



UNITS IN SILENCE: small tubes to complete combustion chambers are tested in the compressor test building of the Army Ballistic Missile Agency at Redstone Arsenal. The cold exhaust test stand is in the background (top and left of center).

Hand-Picked Team Develops Jupiter

By David A. Anderson



STREAKS on ground left by rocket blast mark site of postmortem test stand.



COLD CALIBRATION stand permits tests under simulated operating conditions.

Decaturville, Ala.—Development of ballistic missiles for Army Ordnance Corps is assigned to a hand-picked unit fit with a top priority. The Army Ballistic Missile Agency.

The Agency's work load is currently proportioned between two major missile efforts.

• **Redstone XSM-4-A-16**, a surface-to-air tactical missile that doubles as a development vehicle for the intermediate-range ballistic missile. Redstone may approximate 200 miles. The missile is in production at the Chrysler Corp. in Detroit. Troop training and weaponization has begun with Redstone and it will soon become a field weapon with the Army.

• **Jupiter**, a surface-to-surface intermediate-range ballistic missile (IRBM). Range requirement for this missile is 1,100 nautical miles. Jupiter was originally planned for eventual use by both Army and Navy, but the recent decision issued by Secretary of Defense W. Lee, took operational responsibility for missiles of IRBM range from the Army and gave it to the Air Force. Jupiter will be evaluated technically late this year (1957) against the Air Force requirement. Though developed by IRBM and the better missile probably will go into service with Air Force and Navy. Commanders of ABMA since February 1955 are Maj. Gen. J. E. Medaris who resigned the Agency in November 1955. Chief civilian scientist on an

operating level is Dr. Werner von Braun.

ABMA's organization is unique within the framework of U. S. missile development programs. On a chart, it is a single box with a single line connecting it to the Office of the Chief of Ordnance. There are no other echelons, no other levels of responsibility or authority.

Autonomous Group

It is an autonomous, self-contained organization with the capability to execute the ballistic missile program from basic research right through to the state of missile to flight. The Agency does research and development, design and prototype manufacturing, testing and firing of ballistic missiles. It issues instructions and tests for ballistic missile operations.

It directs and controls the ballistic missile pipeline between industry and traffic out.

ABMA operations are along the lines of two concepts basic to Army Ordnance.

• **Missile armed concept**, which places responsibility and authority for development and procurement of classes of material with a single armed autonomous unit at Detroit, concentration at Joliet, weapons at Rock Island and research at Redstone. ABMA is an Agency, not an arsenal. It is not, as many mistakenly think, a part of Redstone Arsenal, although it is financed and otherwise supported by that arsenal.

• **Weapon system concept**, which places responsibility for development and integration of a new weapon into the hands of a single authority. That concept has been part of written Ordnance Corps policy since 1947. One of the first such systems was the Army's Nike antiaircraft missile with Western Electric Co. carrying the complete responsibility.

To specific within these conceptual boundaries and to carry out its defined mission, ABMA has developed an organization partly classical and partly new. Gen. Medaris has the usual reserve staff and service staff members to assist military administration. But the strongest line on the ABMA chart runs between Medaris' office and the three operating divisions.

• **Development Operations Division**, consisting of two laboratory groups and a technical fusion group.
• **Industrial Operations Division**, made up of the procurement operations and production engineering branches.
• **Support Operations Division**, covering maintenance engineering, supply and distribution and training branches.

Regard of the three main is the Development Operations Division, headed by Von Braun. Here is concentrated the research and development

that goes into the life cycle of a ballistic missile. Theory and practice, fabrication and firing comes under the purview of this division.

The nucleus is formed of ex-Corpsmen, postwar—new U. S. citizens and thoroughly Americanized—who came to this country after a hectic rounding of technical personnel at the end of World War II.

Each of the three laboratories under Von Braun, plus the technical liaison group and the research property office, is headed by one of these men.

Ballistic missiles are an old experience to these developers of the A-4 rocket, father of the Redstone and grandfather to Jupiter. Individual experience with these types of weapons extends back about 20 years for most, longer for some.

Technical backup for these scientists and engineers is a collection of avail-

able facilities—with additional ones being built—that most of the men believe to be the finest anywhere. Digital and analog computers, a Mach 6 wind tunnel with a 14-in. square test section, and a new structural and mechanical laboratory with capacity to test missiles in a vertical attitude under simulated loads, are all part of the extensive laboratory equipment.

But the outstanding portion of the facility is the test stand area.

Test Area Two

The prewar town of Test Area 2 sits the first 400-ft. south of ABMA's modern headquarters building. Forming the grouping is a 340-ft. high concrete basin capable of chugging two Jupiters in one flight test run at the complete missile velocity.

In its present state the test area represents about \$17 million in structures



ARMY REDSTONE is dual-purpose tactical missile and development vehicle for Jupiter (IRBM) project at Army Ballistic Missile Agency. Redstone is intermediate missile; Jupiter line of warhead is put before upper control section. Thrust unit has rectangular control surfaces on suspended fins.

and equipment. It was designed and laid out with the idea of complete flexibility in mind, so that any foreseeable missile, air vehicle, sub-orbiter or component could be checked out under simulated operating conditions—cold or hot—at any stage of its development.

To do this, the AFMIL scientists planned five test stands:

- **Component test**, where units ranging in size from small valves and regulators to complete combustion chambers can be tested under environmental conditions. This is the first stage of an engine's operation.
- **Cold-flow stand**, where post-combustion components can be checked either as individual parts or as a complete system under simulated operating conditions. But in the static injector, these are "cold," low-pressure conditions to establish the basic flow parameters of the system.

- **Pre-ignition stand**, where a complete missile—post-ignition system—trajectories, fuel, combustion chamber—can be positioned in a vertical frame and run through a complete flight cycle. Station performance, starting stability, consistency of performance are just a few of the major results how tests in such a stand.
- **Static test tower**, where a complete missile—static efficiency to be delivered—in pre-flight tested as a complete air vehicle.

This huge concrete tower is the first of its kind to be designed instead of being ordered in a monolithic, it clings to the earth's existing structure that could go as high as half-a-million pounds! It's an Electra-vac kind of tower whose platform and steering arm can be repositioned to simulate data new configurations. In three words, the stand can be completely altered to take one new shape of missile.



Rocketdyne Occupies Neosho Plant

Construction of rocket engine test stand (above) at new facility of Rocketdyne Division, North American Aviation, at Neosho, Mo., across stand is engine assembly manufacturing building (below). Building has 40,000 sq ft of floor space.



It was designed to handle any conceivable shape and size that the missile might demand. Neosho is a standard 45-ton Navy transport crane which hoists the missiles in and out of the tower.

The stand can test two complete missiles at once because of its double-sided design. Near its base are a pair of giant angled buttresses that are the blast deflectors. Between them are enclosed ducts, water inlets during the tests to protect the concrete surface and the loadings. The stand water system has a capacity of 12,000 gallons per minute.

The static test stand, the pre-ignition stand and the cold-flow stand are all tied into a single data-gathering system.

Other Laboratories

Name of the other laboratories in the AFMIL complex define their missions. Availability specifies the wind tunnel and device area, techniques for model and flight testing. The Gasquet line laboratory, in addition to its obvious task, also develops and operates windtunnels.

Model prototypes are built by the Fabrication laboratory, which also is charged with the responsibility for finalizing production of the missile as its mission in industry.

Guidance and Control laboratory continues the aerial navigation system work that began with the substructure system used in the V-2. A major contribution of this lab has been its work on launching guns with cutters, low-altitude.

Launching and handling apparatus and its development is the responsibility of that laboratory. The same mobile units that comprise a Redstone battery were planned and developed in this unit.

Pride of the Structures and Mechanics laboratory hasn't been lost yet, but it's a much different, taller three-story structure that will give the lab much needed space to carry out its job of structural development and test. Part of the new building will be a vertical structure that will take a complete missile for carrying out simulated flight load tests.

Structural Analysis and Reliability labo-



Sparks of this **R** launch— and it's a new concept of service standards in the Aluminum Industry

Olin Mathieson
Chemical Corporation
one of the world's largest
suppliers of Chemicals, Metals and
Packaging Products, announces

an important new source of Aluminum

The logo for Olin Aluminum features the word "OLIN" in a large, bold, sans-serif font. Below it, the word "ALUMINUM" is written in a smaller, all-caps, sans-serif font. A large, stylized letter "A" is positioned between the two words, with its top bar extending to the left and its right leg extending to the right, partially overlapping the "L" in "ALUMINUM".

A MAJOR NEW OLIN MATHIESON DIVISION—WITH A DYNAMIC NEW CONCEPT OF QUALITY AND SERVICE

Important news for users of Aluminum and other metals is the full-scale entrance of Olin Mathieson Chemical Corporation into the primary Aluminum field.

Right now, limited quantities of Olin Aluminum are being produced at four locations, and soon an initial annual capacity of \$40 million pounds will be a reality.

Benefiting from Olin Mathieson's already extensive experience in the metals field, Olin Aluminum will become a major source of unusually fine-quality Aluminum. And as a result of its full integration—from Bauxite to rolling mill—Olin Aluminum will be in a position to assure its customers a dependability of delivery that will be of vital importance.

A New Concept of Service Standards

Of equal significance is Olin Aluminum's new concept of service standards. Its new plant facilities will be the finest, most modern in existence—thus assuring the ultimate in production quality and economy. Its technical staff is composed of men of broad and extensive experience—ready to work side by side with your own engineers toward the one best solution to any of your Aluminum problems. And Olin Aluminum's new sales team consists of men with a minimum of five years of thorough experience in the Aluminum field.

The combination of these three things—new plant, experienced technicians and imaginative service per-

sonnel—will result in Aluminum of competitively superior metallurgical quality, tolerances and finish.

A \$300 Million Investment

Behind the birth of Olin Aluminum lies an exciting industrial dream. Recognizing the growing world need for Aluminum, Olin Mathieson—already greatly experienced in the production of modern metals through its Western Brass Mills Division—joined with Inco Copper and Brass to organize the Olin Inco Metals Corporation. The purpose of this united effort was to construct and operate the complete facilities necessary for the production of primary Aluminum. The Olin Inco Shipping Corporation was formed to import the huge quantities of Bauxite needed, and keels were laid for its three giant new 16,000-ton ore ships of revolutionary design.

Simultaneously, at Bermuda, Louisiana—an ideal deep-water port—construction was begun on a large new

Alumina plant. And on the Ohio River, at Marietta, Ohio, work was begun on the first reduction plant ever to have its own integrated coal supply and power-generating facilities. These new plants, fruits of a \$300 million investment, form the assured source of supply for Olin Aluminum.

Better Tolerances, Finishes and Alloys

Two-thirds of the output of this fully integrated primary Aluminum production system will go directly to the new Olin Aluminum Rolling Mill at nearby Oval, Ohio, and to other Olin Aluminum facilities in the Midwest, on the West Coast and on the Gulf Coast. From these modern plants will flow custom-made Aluminum better adapted to your individual needs than any you have ever before been able to obtain. That is the goal of Olin Aluminum: a new concept of quality and service in the Aluminum industry.

Turn the page for more news about Olin Aluminum



The '57 Beechcraft Twin-Bonanza offers more payload, carries more cargo, has greater range, gives better performance, has more visibility, more passenger comfort, is more quiet, has more safety features, a better safety record, comes more completely equipped, has higher resale value than any other airplane in its class!

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ing Branch of Industrial Operations Division is responsible for living product work which will later facilitate conduct of a production engineering program. To the end, Engineering Branch personnel keep abreast of Research and Development progress and interpret production engineering requirements to the extent that these do not compromise Research and Development efforts. Thus quality assurance program is initiated, arrangements are made for preparation of documentation in accordance with approved format, and engineering service is rendered in liaison between the Research and Development group and the Production Operations Branch which processes all technical communications.

Design Improvements

Beyond the aforementioned research duty during the Research and Development phase, the Engineering Branch of Industrial Operations Division is fully responsible for all engineering work relating to AFMA capable systems when they are made for production in a tactical weapon. The design evolved under the Research and Development program is normally functionally suitable, but this design can often be improved. Such improvements are made to eliminate components that may be difficult to produce or may require excessive amounts of critical materials to change, standard items which may be replaced by standard ones without affecting functioning, or to improve reliability, operability, maintainability, or correct malfunctions which are located during operational suitability evaluations and service use.

Under the Development Operations Division of AFMA, the Engineering Branch of Industrial Operations Division is staffed to perform principally a technical management function. Detailed designs and engineering design production phase is normally placed in engineering service from industrial organizations to other Government agencies.

Management Role

In its managerial role, the agency team of Engineering Branch include the maintenance of controls to assure that all changes to initial design of system equipment to improve the product are accomplish within the system, consistent with user requirements, desirable from all other technical points, and are scheduled so that there will be timely availability of all components which are required for delivery of complete, consistent, initial system on established schedule.

A staff representing a cross-section of the Department of the Army is assigned to the Agency with a single intent: To bring the influence of the user to bear

on the development program at the earliest date.

The Army hopes to use as much as two years in the development cycle at its disposal by using this approach. The Dept. of the Army staff can monitor the progress so that the two years of the using across-organization, simplicity, inductibility, accuracy and flexibility can be built into the model system at its early stage.

Senior officer of the Army staff is Col. C. G. Patterson, whose background activities are in the Research and Development Branch and a tour at the War College where his focus was a study of the influence of technology on

strategy. Other officers on the staff are drawn from Continental Army Command, Office of the Deputy Chief of Staff for Logistics, Fort Monmouth, the majority are combat area officers.

Patterson emphasized that the Army officers are working just at the Agency and not simply liaison types. Only five of the officers perform administrative staff functions, the remaining 12 are not working in the laboratories.

Feedback from these officers to the requirements branch of the Army General Staff is constant, formal and informal, said Patterson. In addition to providing this two-way feedback link between the development agency

*Everybody talks about reliability
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The imagination and engineering skills which created so many outstanding Pratt & Whitney Aircraft engines—from the dependable and efficient Wasp to the widely-used J-57 turbojet—are today pushing ahead in projects which can influence the whole future of aviation.

Operating in the nose of this modified Douglas C-124 test bed aircraft, for example, is the Pratt & Whitney Aircraft T-57 propeller turbine. A major advance in its field, the T-57 combines a power potential never before realized in a propeller turbine with many operating advantages for efficient, long-range flight. Power plants with these capabilities are required for giant aircraft still under development.

Such achievements show Pratt & Whitney Aircraft's ability to develop the right kind of engine at the right time... whether piston engines, turboprops or turboprops—or entirely new engines of the future.

Today, nearly every branch of theoretical and applied science is contributing to progress in aircraft propulsion at Pratt & Whitney Aircraft. Specialists in nuclear physics, advanced metallurgy and electronics, chemical engineering and many other fields—all have vital roles. Whatever form the future takes... in new principles of propulsion, new materials or new fuels.

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Economical Zuni Package

Fireback Navy Zuni rockets are covered, hand-held tests are being made in which they are deflected from safety and stored. Tests are planned after firing. Rockets, which cost \$150 apiece are replacement for World War II High Velocity Airborne Rocket (HVAR). Zuni is taking its solid propellant rocket design for its 10-pound and 20-lb versions are. Cleanup (below) shows taking for Rocket was developed by Naval Ordnance Test Station, China Lake, Calif.



the Air Force Missile Test Center, Coram, Fla. Spurred by the missile performance during these tests, the Army made the decision to go into an SRM program built around the nucleus of Rocket's missile development division.

Gen. Modaris was assigned the job of equipping a new agency to handle the multiple problems of ballistic missiles for the Army, and ARMA was the result. Work on the Redstone weapon system and development of Jupiter progressed on schedule. The only hint of a look away when the first series of the Whiz directive broke in the Bluebird area.

The shims had heavily appeared in level papers before Modaris issued a statement clarifying the problem. It was pointed to bulletin boards and placed with testing steps from office to office. It is credited with averting some of the major pain that always results when policy decisions change the direction of a major program.

Each the following week Modaris re-emphasized some of the points in the Whiz directive for the benefit of his staff. Developmental work on the Jupiter will continue, he told them.

"After all, this is not a new position for Army Ordnance," he said. "We've often used weapons for other services to shoot. We have no production about our contract."

New only are handle remain between Jupiter as a project and Jupiter as a program. The technical evaluation scheduled for this year. At ARMA, they're confident that they will take that handle in their stride.

About 144 million in new contract, which will eventually live on 5,000 acres of Redstone Arsenal's 40,000.

New under construction for ARMA.

- Missile separation and checkout, longer valued at \$2.1 million.
- Guided missile test loop valued at \$1.2 million.
- Structural fabrication laboratory addition valued at \$1.1 million.
- Complete laboratory valued at \$1.457 million.

Contracts have been let for the structure and surface laboratory, a three-story, four-story complex consisting of a structure and enclosure unit, an office building, an engineering, manufacturing, and methods development unit and a shop. Total value of the complex is \$4.25 million.

Approved in expected soon for the construction of other projects, including a powerplant test stand, a technical plant and video instrumentation lab and a surface treatment facility.

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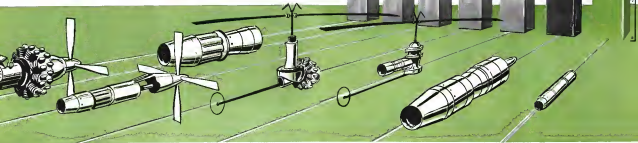
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SMALL JET ENGINES... CHAMPION WEIGHT LIFTERS

An entirely new family of aircraft will evolve from a new family of small lightweight jet engines now under development at the Fairchild Engine Division. These new powerplants will feature incredibly high thrusts and great lifting power... yet will be so light they can easily be carried by two men.

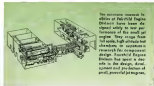
Highly compact, with low frontal areas, the small jet engines will deliver thrust/weight ratios starting at 8 to 1 with a long range potential of more than 10 to 1. They will be used in the high performance, lightweight trainers, interceptors, target drones, pilotless aircraft including missiles and intermediate class passenger and cargo jets of the near-term future. They will also be used to power lightness and utility cargo craft, executive aircraft... and will make jet Short Take Off and Landing (STOL) and Vertical Take Off and Landing (VTOL) aircraft practical.

The small jet engine may be used singly, in pairs and in clusters. It provides multi-engine reliability in aircraft of a size now wholly dependent on a single engine. The small jet engine will produce greater versatility and safety in airplanes of tomorrow.



COMPARISON OF LIFTING CAPACITY OF POWER SYSTEMS

How the new family of Fairchild Small Jet Engines compare with other mechanical lifting systems



The extensive research by officials of Fairchild Engine Division has been the signal ability to use performance of the small jet engine. They range from 100 to 1,000 horsepower and are designed for compact design. Fairchild Engine Division has spent a great deal of time in the design, development and production of small, powerful jet engines.

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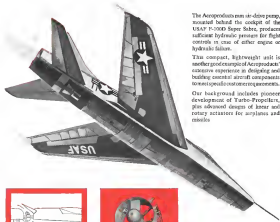
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Aeroproducts air-driven hydraulic pump

in North American F-100D produces emergency power for flight controls



The Aeroproducts ram air-drive pump, mounted behind the cockpit of the USAF F-100D Super Sabre, produces sufficient hydraulic pressure for flight controls in case of either engine or hydraulic failure.

This compact, lightweight unit is another good example of Aeroproducts' extensive experience in designing and building essential aircraft components to meet specific customer requirements.

Our background includes pioneer development of Turbo-Propellers, plus advanced design of linear and rotary actuators for airplanes and missiles.



Lightweight ram air pump is mounted behind engine inlet ducts. In emergencies, air from engine inlet ducts can be diverted by the pilot to drive the ram-air pump.



Weighing only 134 pounds, the Aeroproducts ram air pump produces sufficient hydraulic pressure for flight controls in case of either engine or hydraulic failure.

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X-7 Lands On Nose Spike



Recovery and ground handling details for Lockheed X-7 rocket test vehicle are shown in this sequence at Holloman AFB, N. M. Below: mounting under wing of B-29; the X-7 is mounted on under wheel dolly (top). Nose spike of vehicle is used for parachute assisted landing (left). Workstation check components (right) before the vehicle is loaded into a truck (below). Vehicle is shown in sequence used by rocket boosters (top center), and rocket jets as when main engine contribution is required. X-7 is used to test the Marquardt 16 in. rocket engine for Boeing B-57C (NWS Aug. 6, p. 49). Lockheed built a dozen variants of the X-7, designed the QFV, which used a different and larger Thrust cell booster. This version was destroyed at crash at White Sands.



AVIATION WEEK, April 18, 1957

BOAC Interested in Victor Civil Version

London-British Overseas Airways Corp. is interested in a civil version of the Victor jet bomber.

In its annual report to Britishers Page shareholders, the company chairman, Sir Frederick Harland Page, said BOAC is talking about such a jet for use in the early 1970s. He said it is a more advanced and development of the Victor than the BIP-87 jet transport offered to BOAC in 1971.

He did not give further details of the new project but commented that

it was "construable that such interest was not shown earlier, for the country might well have saved the many millions of dollars BOAC is spending on American aircraft."

The BIP-87 could have been in service well before American jets if it had been ordered in 1972. He described it as a 100-passenger aircraft capable of one-stop operation between London and New York.

Commenting on a previous "prominent" role in the continued study of super-jet transports which has been undertaken by the British aircraft industry. The chairman and Harland Page is studying comparative factor characteristics

and making an analysis of the life and drag of supersonic wings.

The annual review also emphasized the firm's work on boundary layer control. Proposals have been submitted to BOAC for long-range business-jet transports. The report stated that sleep weight of the Boeing B-72 could be reduced from 400,000 lb to 275,000 lb without affecting performance if laminar flow were used.

De Havilland Warns Against Fund Cuts

London-Chairman of the de Havilland Aircraft Co. warned that large British defense cuts will place Britain's aircraft industry in a difficult position to compete with foreign manufacturers.

W. E. Nixon, chairman of de Havilland Holdings, Ltd., said that the U.S. industry has strong government backing with military orders making up nearly 50% of American industry's total sales.

Extra possible support would be given to British research and development efforts and to new projects so that the industry can continue to share in the markets of the world, he said.

In the group's annual report the chairman disclosed that production of Venom and Vampire for the RAF and Royal Navy has been cut back. Production of Ghost and Goshawk jet engines is also declining. Advanced rocket engines in two forms, for takeoff and for flight, are entering the production stage to be installed in what he termed a "new generation of military aircraft."

Tight trials with the Spectre rocket engine already have begun. Noise and flight testing is in larger amounts of the Goshawk turbojet.

Government Explains Troubles With Hunter

London-Minister M.L. IV said that the M.L. IV aircraft comply with all requirements for operational use at all altitudes. Supply Minister Anthony Jones told Commons.

Engines on the M.L. I and IV Hunter are liable to stoppage when the guns were fired. Fitting of modified engines in M.L. IV aircraft began in February, two years after the trouble was first encountered.

Jones said it was not considered worthwhile to modify the M.L. I aircraft. The minister was asked when it was first found that the characteristic of the Hunter were not suitable at a certain speed, when the modification of a moving telephone was first decided upon when this modification was

PRESSURE

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—smoothly, consistently,
and with extreme accuracy!



The poppet type helium relief valve, illustrated below, regulates a missile's fuel tank pressure at 33 PSIG at 1 PSIG at flows from 0 to 1.5 lbs/sec.

An integral check valve permits flow of ambient air into the fuel tank if external pressure falls below ambient.

Also provided is an integral override mechanism—controlled by a solenoid valve—which utilizes an external source of air at 400 PSI to open the valve for vent purposes during filling. This versatile valve can be adjusted for other operating pressures by simply resetting the calibration of the pilot sense unit.

PERFORMANCE

TEMPERATURE: -50°F to +150°F fluid and ambient
ELECTRICAL POWER REQ. FOR SOLENOID OVER-RIDE VALVE: 10-30W @ 12 vdc, 20-40 W @ 24 vdc
SERVICE FLUID: Air/gases, helium, or inert gases vapor
PRESSURE: *33 PSIG at 1 PSIG control pressure, 30 PSIG relief pressure, 35 PSIG burst pressure
TUBE SIZE: 1/2" DIA.
WEIGHT: 3.8 lbs.

*Any desired pressure under 40 PSIG can be furnished.



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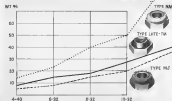
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FASTENER PROBLEM



How important is weight?

Engineers always weight reduction as an important consideration in all aircraft fastener applications. But is it all important? In the final analysis, don't you always also stop to consider whether it is as significant as greater strength and higher performance? Or if you can afford a small weight penalty to achieve a cost saving?

CONCLUSION

But neither what you considered unnecessary is, the ESNA low offers a fastener for your requirements. For example, here are three fasteners not types—each of which offers its own particular advantages:

- Lowest cost and weight with an extra high strength safety factor** are the steel parts with nylon inserts (Type NM), a standard in the aircraft industry for over 50 years. These offer the widest range of uses and application capabilities of any self-locking fastener. (Temp. to 230° F.)
- The highest of any self-locking fasteners** are the high-strength aluminum ones in the blue hard P line (Types MF, M2). They also meet the full AN trade requirements. (Temp. to 330° F.)
- For low clearance, low height applications where full AN strength is desired**, the new ESNA LITE-TM line of lightweight aluminum fasteners is recommended. Designed to NAS-638 drawing for low height nuts they meet MIL-N-20027 performance standards. They also conform to AN304 that size lengths and trade requirements for full-height AN304 and AN305 parts. (Temp. to 330° F.)

ESNA can supply you with the fasteners, the most versatile and economical at the highest temperatures self-locking ones available. To select the fastener that best meets all your important requirements, send for complete information today.

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official and whether he is satisfied that the modified materials are as effective as those fitted on the North American B-50's over eight years ago.

He replied that the greater control was first reported in January, 1955. It was decided in June of that year to proceed with the design of a flying test fleet fully modified aircraft from new production will be delivered in June of this year.

"The aircraft as modified will be a more advanced and more powerful aircraft than the B-50," he stated. "The AF-16 can carry forward to again through service."

Traveling as he is involved in the field of fighter aircraft, it is because he was more substantial than the American to build men and boys in experimenting in aerospace flight."

HDM 105 Transport Makes First Flight

Land-based test flight of the HDM 105 experimental light transport with high-lift wing was made last week.

The four-engine aircraft is a result of collaboration between British designers J. G. Miles, Ltd. and the Société des Avions Fouga Division. The long, narrow wings supported by special lifting struts are expected to give good performance at low cost.

A joint company has been formed to produce improved versions of the prototype. Plans include HDM 100, a 45-passenger transport designed for small field operations. The first cut center it would enable fast on short routes to be reduced to one third.

Also in the future is the HDM 107 turbo-propeller-driven military assault transport.

The company also disclosed plans for entering the air transport business. It has applied for Air Transport Advisory Council for licenses to operate seasonal scheduled passenger, freight and mail services from Britain's Royal Coast to the Channel Islands and the French Channel.

Bradley Page, Managing Director of the British Overseas Airlines, is planned controls for the service.

Breguet Twin Jet Fighter Is Flown for First Time

Breguet twin jet lightweight assault fighter 1930 made first flight at Brétigny, France, (powered by two Turbomeca Calorix turbojets) on July 2, 1955. Based, aircraft is considered category of limited interest, NATO version of the aircraft is being equipped with Bristol Siddeley engine. Second prototype of twin jet version is destined for use in Naval command operations.



The first Pantobase BLC transport

The usefulness of military transport aircraft has been substantially increased with the introduction of the Stroukoff C-134. Positioned for the United States Air Force this rugged heavyweight requires extremely short take-off and landing runs and can operate from any surface—land, sea, ice, water, etc. Advanced airframe design has been

combined with Stroukoff Pantobase and Bendway Lower Control Systems to produce a new type of aircraft equipped for a variety of assault and logistic missions requiring operation without the limitation of conventional runways.

The Stroukoff C-134 is destined for an important role in modern military strategy

Interesting opportunities for qualified engineers in many fields exist at Stroukoff



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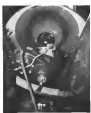
AIRCRAFT CORP.

WEST TRENTON, N. J.



ACCESSIBILITY to T3 and drive shafts is aided by external power (pig). Engine cowling (removed) can be pivoted aside about quick-release pins or cutaway dismounted. Stuck-on steel engine supports transfer loads to twin tail booms. "Pig" on exhaust ducts forces gas.

OIL COOLER and tank (left) serve gas turbine, larger cooler and air tank, on other side, serve transmission. Filings are removed. Helicopter will flow two heavily pigged booms or into plasma chamber beneath cooler. Cooling air is exhausted via gill openings.



TURBINE valve opens and speeds (check-point), drive shaft, main disk hub, turbine/transmission speed reduction unit and generator (last) take.



EXTERNAL cargo hook can handle loads too awkward to store in K-600-3 rotor via drive shaft door. The K-600-3 is a modified version of Kaman's BK-6, built for Navy.

Two Turbine Versions of HOK-1 Offered

Kaman K-600-4 Performance

(Powerplant) 2 Modems Turbulent

	2 Place	3 Place	3,000 lb Cargo Carrier
Useful load (lb)	1,800	2,340	3,770
Crew	200	200	200
Passengers	200	200	200
Cargo			
Fuel	1,200	1,200	470
Maximum disk (lb)	300	300	100
Empty weight (lb)	3,555	3,555	3,925
Gross weight (lb)	4,755	4,755	7,225
Standard Day Performance			
Vertical climb (ft/sec)	160	160	
Vertical climb (ft/sec)	1,610	1,360	140
Absolute hovering ceiling (ft)	12,300	12,000	
Absolute hovering ceiling (ft)	18,000	13,200	4,000
Maximum climb (ft/sec)	1,250	1,130	500
Maximum climb (ft/sec)	1,580	1,470	900
Service ceiling (ft)	32,200	30,600	12,700
Speed (ft/sec)	121	99.3	95
Speed (ft/sec)	166.9,000	103.6,000	95.5L
Range (ft/sec)	177	173	66
Range (ft/sec)	200	192	54
Cruise speed (ft/sec)	72	81	84
Cruise speed (ft/sec)	80	77	80
Endurance (hr)	3.47	3.34	784
Endurance (hr)	3.52	3.25	1
Cross speed (ft/sec)	43	44	31
Cross speed (ft/sec)	43	44	31

*Normal power 600 hp; *Military power 720 hp; **Emergency operation; One-engine operation.

New York-Stony Brook effort to obtain military contracts from U.S. and Canadian military services for two new helicopter versions of the BK-6, 1 helicopter is being made by Kaman Aircraft Corp., Bloomfield, Conn.

If commercial interest develops in these models, Kaman will market the Civil Aerobics Administration version of them, but military orders on hand already a complete spokesman told Aviation Week.

Both types are modified versions of the polymorphic BK-6, which has been in production since 1957. Some 16,000 BK-6's are in service and contracts call for output continuing until 1970. New models being developed are:

*K-600-1 powered by a single Lycoming 155-hp turbine which Kaman has been testing since last September. To date the K-600-1 has completed more than 50 hr of operating time including 10 hr of turbine test and 10 hr of flight time showing which it is allowed speeds up to 115 kt and been to 7,000-ft altitudes.

*K-600-4, another version of the BK-6, is still in the engineering development stage for installation of two (initially) Blackburn & General Aircraft (GAC) turbines. Kaman has purchased two of these powerplants and is busy on the design boards developing the conversion. Paper studies of the Turbine 600-powered BK-6 have been submitted to U.S. and Canadian military authorities.

Of the two projects the twin Turbine

to Military

K-600-4 will probably be of greatest interest to commercial operators because of its single-engine operating characteristics. One has a 740-hp engine rated at 110-hp. Air Registration Board certification tests in England and a production, Kaman told Aviation Week.

Data relating to power developed by the twin Turbine has been brought in line with the T35 to provide early comparison. Twin Turbine maximum power is 900 hp, continuous rating is 560 hp. Actual developed power for installation in the BK-6 were not available at this writing. This probably will be higher than data derived ratings of the T35, according to Kaman.

Performance another indicator that the K-600-4 cargo carrier will have direct operating costs of \$1.37 per hour. With a pilot and seven passengers, with maintenance costs are estimated at 15 cents.

Intermediate data from the search from P-9, K-1140, piston engine to turbine installation is a group in testing capacity from five to eight persons or 1,000 lb of cargo, made possible by approximate doubling of usable cabin area to 170 sq ft. Turbine installation is critical, about the cabin. The piston engine is installed at the rear of the cabin interval, with access to the latter by means of a retractable split door that doors.

Doors are retained to the turbine power to provide one of loading. Pilot operating procedures are used considerably with the turbine engine. A turbine power control system (ignition) automatically provides proper power demanded by the pilot when he

	2 Place	3 Place	3,000 lb Cargo Carrier
Useful load (lb)	1,800	2,340	3,770
Crew	400	400	200
Passengers		340	
Cargo			3,000
Fuel	1,200	1,200	470
Maximum disk (lb)	100	100	100
Empty weight (lb)	3,790	3,790	3,790
Gross weight (lb)	4,990	4,990	7,590
Standard Day Performance			
Vertical climb (ft/sec)	1,130	420	
Vertical climb (ft/sec)	1,980	1,300	300
Maximum climb (ft/sec)	1,400	1,300	480
Maximum climb (ft/sec)	3,260	1,770	1,080
Maximum speed (ft/sec)	147	104	95
Absolute hovering ceiling (ft)	18,000	14,200	
Absolute hovering ceiling (ft)	19,000	12,700	7,000
Service ceiling (ft)	32,500	32,000	15,200
Range (ft/sec)	240	150	80
Endurance (hr)	3.8	3.4	1.6
Military Day Performance			
Hovering out of ground effect (ft/sec)	9,200	2,000	
Hovering out of ground effect (ft/sec)	10,200	6,000	

*Pressing 150 in rated at 825 hp (tailshaft) and 270 hp (mainshaft). For K-600-3 variations range are 500 hp (maximum continuous) and 720 hp (military). **Maximum continuous power; *Military power.

achieves girth stick and it also maintains rotor rpm at the constant speed prescribed by the pilot. Maintenance also is eased because of the engine's external mounting. In addition the T35 being a free turbine, no weight clutch system is required.

Comparative analysis of K-600 (BK-6) 1) performance with its turbine-powered outboard, weight weight of the K-600 is 4,010 lb; at the K-600-1, 3,790 and of the K-600-4, 3,915. Max gross weight of the K-600 is 6,500 lb, the turbine-powered model max-

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RIGHT ARM, including pilot, spacer, and enlarged wrist area of the helicopter. Removal of wrist, using two wood screws.

mean grain is given as 3,725 lb. Vertical rate of climb for the K-600 at 7,500 lb is 500 fpm, at 6,500 lb, it is 140 fpm. For the K-600-1, vertical rate of climb at 7,550 lb is 500 fpm at military power. Maximum rate of climb of the piston K-600 is 790 fpm, for the T53 powered K-600-3, maximum climb rate is 1,080 fpm at top gross weight.

Maximum speed at sea level for the K-600 is 90 kt; turbine screws have a maximum speed of approximately 96 kt at about 7,740 hp. Maximum useful load of the Russian K-600 is 2,740 ft.

[illegible]

for the turbine-powered variants at 1.775 in.

HOKI with TSI currently installed is operated by Krons on a business contract from Navy, to provide light development on the powerplant, which is a U.S. Army project under direction of the U.S. Air Force Power Plant Laboratory. Turbine HOKI is scheduled to be delivered to Learning Center in about a month for a 100 hr test.

Kaman has provided additional computer funds to develop the T51 testbed installation into a prototype of a low-power "in being" helicopter.

Suitable surface protection and better joining methods are the primary needs for staying molibdenum at jet engines, R. T. Bagley, Aviston Gas Turbine Div., Westinghouse Corp., told the Society of Automotive Engineers' Automotive Meeting.

Extruding[®] results were obtained from a number of sheet metal tail-fin elastic vanes fabricated from laser-cut 90% Co-nickel-titanium alloy, Inghy steel. The sheet was clad on both sides and fabricated in stretch-forming.

No particular difficulty was encountered with the forming operation when the metal was heated to 500-600°C. The breaking edges of the cones were

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Advanced Systems Engineering for Commercial Flight by Honeywell Aero

For three new American Jet Transports— Transistorized Fuel Gage by Honeywell

SINCE America's first three jet transports, now in rush production, will be shortening flying time to points all over the globe. And Honeywell Aero is proud that these planes will carry a Honeywell Transistorized Fuel Gage—the most accurate, the most reliable fuel gage available today.

This new fuel gage retains the pinpoint accuracy of the famous Honeywell electron tube gage. It can measure any fuel load to within two percent, and has these added advantages: less weight and bulk, a smaller power requirement, greater ruggedness, longer life.

For these reasons, the Honeywell Transistorized Fuel Gage was a logical choice for the Boeing 707, the Douglas DC-8, the Lockheed Electra.

The transistorized fuel gage is another Honeywell "first"—made possible by Honeywell's development of the power transistor.

For more detailed information on the new Honeywell Transistorized Gage and its applications in both commercial and military aircraft, write to Dept. AW4 123, Mail Station 654, 2608 Ridgway Road, Minneapolis 13, Minnesota.

Honeywell

Aeronautical Division



Douglas DC-8, Pan American, Panagra, and Eastern Airlines have ordered 53 Douglas DC-8 jets with Honeywell's Transistorized Fuel Gage. Deliveries are in flight in 1958.



Boeing 707 transports: 321 of this jetliner transport have been ordered by 10 different airlines, with deliveries scheduled for 1957 and 1958. The 707 will be equipped with Honeywell's Transistorized Fuel Gage.



Lockheed Electra: 8 different airlines have placed orders for a total of 113 of Lockheed's turboprop transport, with deliveries to start later in 1958. The Electra will be equipped with Honeywell's Transistorized Fuel Gage.

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stead by leaving with No. 2-B after and the moldmakers at the exposed top and bottom edges of the ramp was protected by applying a thin layer of the mac leaving allow to each end. "Channel seals, endseals and sand crosses both were run on these runs installed in a conventional first stage turbine engine. During the test peak temperatures at 2,000° were encountered, with the average gas temperatures at these locations 1,500°.

Though cracks did appear at the lower trailing edge joints, Begley said that the resulting outboard of the moldmakers box was not excessive.

Landing Aids Advocated For Good Weather Too

Use of automatic landing aids in good weather as well as bad was advocated by Brig. Gen. Joseph D. Gables, director of USAF flight safety research at the Society of Automotive Engineers Aeronautical meeting. Landing aids develop account for 45% of all major Air Force flight mishaps, he said, and the majority of these occur during normal landings in good weather.

Increased landing speeds and the difficulty of handling high performance planes at low speed are not the only factors causing trouble in jet landing.

The pilots depth perception is adversely affected after a long flight at high altitude where he is removed from ground distance references. This is believed to contribute to the number of over and under shots the Century Star fighter pilots make on landing.

The Air Force is studying both its own automatic systems and other proposed and existing automatic landing systems in an effort to ease this problem.

Aerocraft Range Test On Thrust Reverser

Los Angeles-Aerocraft General Corp. has successfully tested its Aerocraft thrust reverser on an Allison J71 jet engine. The thrust-reverser was developed by Aerocraft General under license from the Pratt & Whitney SNECMA. Test on the J71 involved 170 hours of runs. Maximum reverse thrust, the tests showed, could be obtained in about 34 seconds.

With modifications, the thrust reverser could be adapted to other jets.

Vertical Lift Research Craft Makes First Flight

Short SC-1 vertical lift research aircraft made its first flight last week at Rosamond Down, leaving a quip of an hour. Some of flight tests will provide an attempt to convert from forward to hovering flight in to take off vertically.



ST. LAWRENCE OR RIO GRANDE How is there . . . of 200 airports from Miami to Tulsa? Even business trips are pleasure trips—when you make a habit of putting down where there's an Esso Aviation Dealer. They're world-famous for their fine service (and, of course, for their fine Esso fuels and lubricants too!) And here's a smart tip: get on Esso Aviation Credit Card. It's your passport to charge-account convenience with any Esso Aviation Dealer. Lets you charge gasoline, oil and lubrication plus tire and battery service, landing fees, overnight in-transit storage and minor emergency repairs.



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Any aircraft landing gear requirement you have can be solved by Cleveland Pneumatic. The gear can be designed around a conventional AEROL, a new-type high-pressure AEROL, or a Cleveland Pneumatic liquid spring. We engineer and produce all three types of shock absorbers.

If space aboard is extra-tight, the small-cubage Cleveland Pneumatic liquid spring gives you the greatest shock absorption in the smallest package. Static pressures as high as 20,000 psi can be used.

Another weight- and space-saver is the high-pressure AEROL. It was developed by Cleveland Pneumatic to operate at 5,000 psi static pressure

with special CPT pressure tests. (Tests were successful up to 8,000 psi static.)

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OF HIGH PRESSURE**

Comparison of (left) standard low-pressure AEROL, (middle) medium-pressure AEROL and (right) high-pressure AEROL. Note reduction in diameter of shock absorber package.

Weight with 1000 psi static pressure
Pressure 1000 psi
Stroke 10 in.
Diameter 1.5 in.

Weight with 3000 psi static pressure
Pressure 3000 psi
Stroke 10 in.
Diameter 1.0 in.

Weight with 5000 psi static pressure
Pressure 5000 psi
Stroke 10 in.
Diameter 0.75 in.

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MANAGEMENT

GE to Put Accessory Department Under Weapons System Concept

By Robert Cushman

Leon, N.H.—General Electric's Aircraft Accessory Turbine Dept. is altering its engineering and sales techniques to fit the weapons system concept of USAF and Navy.

USAF's weapons system philosophy has been well dominated on the surface level by General's B-58 weapons system.

It is making its full impact felt upon the subsection level, as evidenced by GE management policy change.

Sold Separately

In effect, GE is gathering up the bits and pieces it has been selling separately and wrapping them up on one package designed to be attractive to the large weapons system prime contractors.

General Electric now expects to be in a strong position to bid on complete airborne accessory power systems. The Turbine Department has formed the nucleus of a new group of weapons equipment who will provide the technical know-how. The department has backed up this group by interposing the B-58 drive section, Schenectady, N. Y., branch part of the Aircraft Products Dept., with the AAT Dept. won't generate drive. The AAT Department probably will be organized to cover its broadened scope.

Because this new 25 man systems group now will be working for both GE's pneumatic and hydraulic drive sections, auxiliary and missile main factories will be the first time by offering a comparison of their two competitive drives, according to Walter C. O'Connell, general manager, AAT Dept.

Current Production

The Turbine Department currently is making pneumatic auxiliary drives for the Boeing B-52 auxiliary power system. The constant speed hydraulic section has been supplying hydraulic drives for the generators on the Douglas A-1H Skyhawk.

Chief Engineer Richard Kilduff, of the Aircraft Accessory Turbine Department, explained some of the system considerations.

Plant floor has assigned quarters needs control energy capable of being applied at the many remote locations about the

aircraft. This is usually in the form of pneumatic or stored electrical energy.

In the case of a tank, the electronic gradient not only needs energy for its corresponding remotely located flow lines, but needs power to run itself. In addition, most modern aircraft use electrical power in the form of power-controlled alternating current. Alternating current power transformers and if accurately controlled, can be used as a time standard for navigation and other devices.

Most potential aircraft use the same propulsive plant in the initial source of accessory system energy. Unfortunately, the loads and speeds needed for propulsion do not coincide with the loads and constant speed needed for accessory systems.

This is particularly true in landing, where the engine is idled back, but a good portion of the control power is still needed.

In standby, accessory power is still used after fuel has burned, at which time the engine is very likely to be used to start the engine at that time or when it is used in the next take

offensive power source is checked constantly.

Kilduff would not be surprised to see independent power sources used in larger aircraft. For example, he said that in place of the B-52 category and larger the power demands are becoming such that a 150-horsepower engine (also made by GE in 1960) just for generating the accessory power would not be out of order. Since it would be running at constant speed part of the power delivery problem, that of delivering constant frequency power of delivering constant speed source would be eliminated.

Drive Compromise

At the present time, however, most of the compromise requires between power source drives which use same engine, compressors, bleed air and hydraulic system drive off the main engine.

According to statistics made by AAT, pneumatic systems are best for preliminary engines in place with short missions, for takeoff and short flights. The pneumatic system requires about 1000 rpm for direct drive, or for rough where there is no source of mechanical power.

Hydraulic direct drives are best for long range aircraft because of their inherently higher efficiency, for engines which are sensitive to compressor bleed, for burner engine configurations



Martin Models P6M Line

Scale model of P6M Submarine was made by Oliver L. Martin Co., to give plant personnel quick familiarity with the overall manufacturing process for the Navy airplane. Model was used as guide to establish the actual production line.

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pressure on applied test pressure or it can be operated manually to demonstrate the effects of unbalanced pressures.

Whenever the USAF partial pressure suit is used, a Scott Test Console is needed for initial training and periodic indoctrination. It provides a means for determining whether each man is physiologically capable of adapting to high positive pressure conditions.

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where they don't add to the frontal area, and for weapon systems which have high electrical loads.

One of the goals of the new group at Ames is to progress the general power take-off problem in a general purpose IBM 704 computer so that, when the sales department brings in a new electronic measurement representation, the group can gain the special case into the computer and in a short order output up with the power system that looks best.

For the time being, this new group will output itself to supplying necessary power to the air distribution bus. However, the AAF Dept has other projects which could be phased into more electronic system studies in the future. They have been working on a line of centrifuge engine simulation, which out of a very compact package can supply bursts of very high horsepower from a 54-in. package; they run positive 20 hp, from a 24-in. package they can produce 150 hp.

AAF also has pneumatic actuators and turbopumps for fluid and hydraulic power.

GE is its Direct Current Motor and Generator Dept., Erie, Pa., makes an alteration through the alterations used on the B-57 are being made by Westinghouse.

Although with three three product lines and various electrical units of units which are made in GE's Waltham, Va., plant, GE would appear to have the complete in-house capability to sup-

ply all of any system or subassembly. O'Connell says that there is no intention that GE will try to make all of the components. For example, he said, GE will continue to encourage them to use Proco Products, a division of Borg-Warner which specializes in pumps, to supply pumps.

O'Connell strongly feels that headway of a large supplier under the weapons systems concept to try to make everything under his own roof will only prove a poor business in the long run. In this respect he agrees with the studies from time to time done relative to the net financial gaps compared with the large loans and use of providing special loans for these gaps.

O'Connell thinks that the data of the path supplier who relies on heavy competition with itself does not benefit.

New York Airport Passengers Increase

New York—Three of the four metropolitan area airports operated by the Port of New York Authority handled 13,090,833 passengers in 1966, an increase of 13.6% over the 1965 total. LGA airport handled 5,083,399 of the passengers, New York International 4,490,018, Newark 2,485,796. Figures not served by scheduled airlines, had 222,167 plane movements.

An airport survey at the airports to total more than 525 million lb., up



TWA Overhaul Base Progress

TWA World Airline's new \$25 million overhaul base near Kew-Forest, a scheduled for summer 1967 completion. Large overhaul building, lower airport structure in picture, already is set by the airline. Hangar is still under construction. Base is located on Fiske County's Mid-County International Airport, 35 mi. northwest of Kew-Forest.

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0.99, and was up 7.49% to \$2.5 million.

PNVA spent \$13.2 million on airport improvements during 1976, expects to lay out \$50.9 million in capital expenditures this year. Gross operating revenues from the four airports and new mid-Missouri airport totaled \$17.9 million during 1976.

Most of the agency's 1976 investment went into Schertz, where a \$130 million "terminal city" is under construction. Installation by Civil Aeronautics Administration of bi-directional instrument landing systems at Newark and Midland was begun during the year.

Of the total passengers, 30,576,985 were domestic and 1,539,999 overseas.

TWA's Burgess Moves Top Level Personnel

New York—Carter I. Burgess, Trans World Airlines president, is recognizing the carrier's top level personnel is line with a reorganization plan previously announced (AW Feb. 9, p. 41).

The changes, effective immediately, include:

- **Frank E. Bush**, vice president-operations, is shifted from Kansas City to New York.
- **George H. Clay**, former vice president and secretary, becomes vice president-administrative services in Kansas City.
- **Donald Duckworth**, former assistant treasurer, has been named secretary of the company.
- **W. E. Rucker**, general auditor for several airlines, becomes assistant treasurer.
- **James Penney**, director of industrial relations, becomes assistant vice president in charge of industrial relations.

In the operations department, seven new certified, Atlantic and western regions are absorbed into two basic divisions—international and domestic.

These will become general manager of United States operations in Kansas City. W. E. Tawick will be general manager of international operations in Paris.

TWA which posted \$246,181,000 in operating revenues in 1976, reported a net loss of \$2,237,900. Loss was 78 cents a share on 5,817,836 shares outstanding, compared to a \$5,497,000 profit in 1975, or \$1.61 a share. Gross revenues in 1975 totaled \$217,414,890. TWA posted 4,125,000 passengers during 1976, a 38.5% increase over 1975.

Under its new president, executives and management increases have been initiated. First fall use of a new over land line at Kansas City will be gone, his new aircraft are being introduced, and second the model service is comparable with Northwest Airlines is expected to begin this year.

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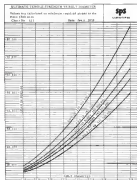
The most 177 shaker is now rated as "wide-band" shaker designed for high frequency vibration and burst tests. It is the only shaker in the company catalog.

1. **CAUDYNE** 177 shaker has constant force output up to 5000 lbs. and constant frequency output up to 1000 Hz. It is the only shaker in the company catalog.
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System Model	Type of Shaker	Force Output	Frequency Range	Amplification	Mass/Weight	Load Capacity
177-100	Electromechanical	1000 lbs.	5-1000 cps	1-1000 cps	100 lbs.	100 lbs.
177-200	Electromechanical	2000 lbs.	5-1000 cps	1-1000 cps	200 lbs.	200 lbs.
177-400	Electromechanical	4000 lbs.	5-1000 cps	1-1000 cps	400 lbs.	400 lbs.
177-800	Electromechanical	8000 lbs.	5-1000 cps	1-1000 cps	800 lbs.	800 lbs.
177-1600	Electromechanical	16000 lbs.	5-1000 cps	1-1000 cps	1600 lbs.	1600 lbs.
177-3200	Electromechanical	32000 lbs.	5-1000 cps	1-1000 cps	3200 lbs.	3200 lbs.
177-6400	Electromechanical	64000 lbs.	5-1000 cps	1-1000 cps	6400 lbs.	6400 lbs.
177-12800	Electromechanical	128000 lbs.	5-1000 cps	1-1000 cps	12800 lbs.	12800 lbs.
177-25600	Electromechanical	256000 lbs.	5-1000 cps	1-1000 cps	25600 lbs.	25600 lbs.
177-51200	Electromechanical	512000 lbs.	5-1000 cps	1-1000 cps	51200 lbs.	51200 lbs.
177-102400	Electromechanical	1024000 lbs.	5-1000 cps	1-1000 cps	102400 lbs.	102400 lbs.
177-204800	Electromechanical	2048000 lbs.	5-1000 cps	1-1000 cps	204800 lbs.	204800 lbs.
177-409600	Electromechanical	4096000 lbs.	5-1000 cps	1-1000 cps	409600 lbs.	409600 lbs.
177-819200	Electromechanical	8192000 lbs.	5-1000 cps	1-1000 cps	819200 lbs.	819200 lbs.
177-1638400	Electromechanical	16384000 lbs.	5-1000 cps	1-1000 cps	1638400 lbs.	1638400 lbs.
177-3276800	Electromechanical	32768000 lbs.	5-1000 cps	1-1000 cps	3276800 lbs.	3276800 lbs.
177-6553600	Electromechanical	65536000 lbs.	5-1000 cps	1-1000 cps	6553600 lbs.	6553600 lbs.
177-13107200	Electromechanical	131072000 lbs.	5-1000 cps	1-1000 cps	13107200 lbs.	13107200 lbs.
177-26214400	Electromechanical	262144000 lbs.	5-1000 cps	1-1000 cps	26214400 lbs.	26214400 lbs.
177-52428800	Electromechanical	524288000 lbs.	5-1000 cps	1-1000 cps	52428800 lbs.	52428800 lbs.
177-104857600	Electromechanical	1048576000 lbs.	5-1000 cps	1-1000 cps	104857600 lbs.	104857600 lbs.
177-209715200	Electromechanical	2097152000 lbs.	5-1000 cps	1-1000 cps	209715200 lbs.	209715200 lbs.
177-419430400	Electromechanical	4194304000 lbs.	5-1000 cps	1-1000 cps	419430400 lbs.	419430400 lbs.
177-838860800	Electromechanical	8388608000 lbs.	5-1000 cps	1-1000 cps	838860800 lbs.	838860800 lbs.
177-1677721600	Electromechanical	16777216000 lbs.	5-1000 cps	1-1000 cps	1677721600 lbs.	1677721600 lbs.
177-3355443200	Electromechanical	33554432000 lbs.	5-1000 cps	1-1000 cps	3355443200 lbs.	3355443200 lbs.
177-6710886400	Electromechanical	67108864000 lbs.	5-1000 cps	1-1000 cps	6710886400 lbs.	6710886400 lbs.
177-13421772800	Electromechanical	134217728000 lbs.	5-1000 cps	1-1000 cps	13421772800 lbs.	13421772800 lbs.
177-26843545600	Electromechanical	268435456000 lbs.	5-1000 cps	1-1000 cps	26843545600 lbs.	26843545600 lbs.
177-53687091200	Electromechanical	536870912000 lbs.	5-1000 cps	1-1000 cps	53687091200 lbs.	53687091200 lbs.
177-107374182400	Electromechanical	1073741824000 lbs.	5-1000 cps	1-1000 cps	107374182400 lbs.	107374182400 lbs.
177-214748364800	Electromechanical	2147483648000 lbs.	5-1000 cps	1-1000 cps	214748364800 lbs.	214748364800 lbs.
177-429496729600	Electromechanical	4294967296000 lbs.	5-1000 cps	1-1000 cps	429496729600 lbs.	429496729600 lbs.
177-858993459200	Electromechanical	8589934592000 lbs.	5-1000 cps	1-1000 cps	858993459200 lbs.	858993459200 lbs.
177-1717986918400	Electromechanical	17179869184000 lbs.	5-1000 cps	1-1000 cps	1717986918400 lbs.	1717986918400 lbs.
177-3435973836800	Electromechanical	34359738368000 lbs.	5-1000 cps	1-1000 cps	3435973836800 lbs.	3435973836800 lbs.
177-6871947673600	Electromechanical	68719476736000 lbs.	5-1000 cps	1-1000 cps	6871947673600 lbs.	6871947673600 lbs.
177-13743895347200	Electromechanical	137438953472000 lbs.	5-1000 cps	1-1000 cps	13743895347200 lbs.	13743895347200 lbs.
177-27487790694400	Electromechanical	274877906944000 lbs.	5-1000 cps	1-1000 cps	27487790694400 lbs.	27487790694400 lbs.
177-54975581388800	Electromechanical	549755813888000 lbs.	5-1000 cps	1-1000 cps	54975581388800 lbs.	54975581388800 lbs.
177-109951162777600	Electromechanical	1099511627776000 lbs.	5-1000 cps	1-1000 cps	109951162777600 lbs.	109951162777600 lbs.
177-219902325555200	Electromechanical	2199023255552000 lbs.	5-1000 cps	1-1000 cps	219902325555200 lbs.	219902325555200 lbs.
177-439804651110400	Electromechanical	4398046511104000 lbs.	5-1000 cps	1-1000 cps	439804651110400 lbs.	439804651110400 lbs.
177-879609302220800	Electromechanical	8796093022208000 lbs.	5-1000 cps	1-1000 cps	879609302220800 lbs.	879609302220800 lbs.
177-1759218604441600	Electromechanical	17592186044416000 lbs.	5-1000 cps	1-1000 cps	1759218604441600 lbs.	1759218604441600 lbs.
177-3518437208883200	Electromechanical	35184372088832000 lbs.	5-1000 cps	1-1000 cps	3518437208883200 lbs.	3518437208883200 lbs.
177-7036874417766400	Electromechanical	70368744177664000 lbs.	5-1000 cps	1-1000 cps	7036874417766400 lbs.	7036874417766400 lbs.
177-14073748835532800	Electromechanical	140737488355328000 lbs.	5-1000 cps	1-1000 cps	14073748835532800 lbs.	14073748835532800 lbs.
177-28147497671065600	Electromechanical	281474976710656000 lbs.	5-1000 cps	1-1000 cps	28147497671065600 lbs.	28147497671065600 lbs.
177-56294995342131200	Electromechanical	562949953421312000 lbs.	5-1000 cps	1-1000 cps	56294995342131200 lbs.	56294995342131200 lbs.
177-112589980684262400	Electromechanical	1125899806842624000 lbs.	5-1000 cps	1-1000 cps	112589980684262400 lbs.	112589980684262400 lbs.
177-225179961368524800	Electromechanical	2251799613685248000 lbs.	5-1000 cps	1-1000 cps	225179961368524800 lbs.	225179961368524800 lbs.
177-450359922737049600	Electromechanical	4503599227370496000 lbs.	5-1000 cps	1-1000 cps	450359922737049600 lbs.	450359922737049600 lbs.
177-900719845474099200	Electromechanical	9007198454740992000 lbs.	5-1000 cps	1-1000 cps	900719845474099200 lbs.	900719845474099200 lbs.
177-1801439690948198400	Electromechanical	18014396909481984000 lbs.	5-1000 cps	1-1000 cps	1801439690948198400 lbs.	1801439690948198400 lbs.
177-3602879381896396800	Electromechanical	36028793818963968000 lbs.	5-1000 cps	1-1000 cps	3602879381896396800 lbs.	3602879381896396800 lbs.
177-7205758763792793600	Electromechanical	72057587637927936000 lbs.	5-1000 cps	1-1000 cps	7205758763792793600 lbs.	7205758763792793600 lbs.
177-14411517527585587200	Electromechanical	144115175275855872000 lbs.	5-1000 cps	1-1000 cps	14411517527585587200 lbs.	14411517527585587200 lbs.
177-28823035055171174400	Electromechanical	288230350551711744000 lbs.	5-1000 cps	1-1000 cps	28823035055171174400 lbs.	28823035055171174400 lbs.
177-57646070110342348800	Electromechanical	576460701103423488000 lbs.	5-1000 cps	1-1000 cps	57646070110342348800 lbs.	57646070110342348800 lbs.
177-115292140220684697600	Electromechanical	1152921402206846976000 lbs.	5-1000 cps	1-1000 cps	115292140220684697600 lbs.	115292140220684697600 lbs.
177-230584280441369395200	Electromechanical	2305842804413693952000 lbs.	5-1000 cps	1-1000 cps	230584280441369395200 lbs.	230584280441369395200 lbs.
177-461168560882738790400	Electromechanical	4611685608827387904000 lbs.	5-1000 cps	1-1000 cps	461168560882738790400 lbs.	461168560882738790400 lbs.
177-922337121765477580800	Electromechanical	9223371217654775808000 lbs.	5-1000 cps	1-1000 cps	922337121765477580800 lbs.	922337121765477580800 lbs.
177-1844674243530955161600	Electromechanical	18446742435309551616000 lbs.	5-1000 cps	1-1000 cps	1844674243530955161600 lbs.	1844674243530955161600 lbs.
177-3689348487061910323200	Electromechanical	36893484870619103232000 lbs.	5-1000 cps	1-1000 cps	3689348487061910323200 lbs.	3689348487061910323200 lbs.
177-7378696974123820646400	Electromechanical	73786969741238206464000 lbs.	5-1000 cps	1-1000 cps	7378696974123820646400 lbs.	7378696974123820646400 lbs.
177-14757393948247641292800	Electromechanical	147573939482476412928000 lbs.	5-1000 cps	1-1000 cps	14757393948247641292800 lbs.	14757393948247641292800 lbs.
177-29514787896495282585600	Electromechanical	295147878964952825856000 lbs.	5-1000 cps	1-1000 cps	29514787896495282585600 lbs.	29514787896495282585600 lbs.
177-59029575792990565171200	Electromechanical	590295757929905651712000 lbs.	5-1000 cps	1-1000 cps	59029575792990565171200 lbs.	59029575792990565171200 lbs.
177-118059151585981130342400	Electromechanical	1180591515859811303424000 lbs.	5-1000 cps	1-1000 cps	118059151585981130342400 lbs.	118059151585981130342400 lbs.
177-236118303171962260684800	Electromechanical	2361183031719622606848000 lbs.	5-1000 cps	1-1000 cps	236118303171962260684800 lbs.	236118303171962260684800 lbs.
177-472236606343924521369600	Electromechanical	4722366063439245213696000 lbs.	5-1000 cps	1-1000 cps	472236606343924521369600 lbs.	472236606343924521369600 lbs.
177-944473212687849042739200	Electromechanical	9444732126878490427392000 lbs.	5-1000 cps	1-1000 cps	944473212687849042739200 lbs.	944473212687849042739200 lbs.
177-1888946425375698085478400	Electromechanical	18889464253756980854784000 lbs.	5-1000 cps	1-1000 cps	1888946425375698085478400 lbs.	1888946425375698085478400 lbs.
177-3777892850751396170956800	Electromechanical	37778928507513961709568000 lbs.	5-1000 cps	1-1000 cps	3777892850751396170956800 lbs.	3777892850751396170956800 lbs.
177-7555785701502792341913600	Electromechanical	75557857015027923419136000 lbs.	5-1000 cps	1-1000 cps	7555785701502792341913600 lbs.	7555785701502792341913600 lbs.
177-15111571403005584683827200	Electromechanical	151115714030055846838272000 lbs.	5-1000 cps	1-1000 cps	15111571403005584683827200 lbs.	15111571403005584683827200 lbs.
177-30223142806011169367654400	Electromechanical	302231428060111693676544000 lbs.	5-1000 cps	1-1000 cps	30223142806011169367654400 lbs.	30223142806011169367654400 lbs.
177-60446285612022338735308800	Electromechanical	604462856120223387353088000 lbs.	5-1000 cps	1-1000 cps	60446285612022338735308800 lbs.	60446285612022338735308800 lbs.
177-120892571224044677470617600	Electromechanical	1208925712240446774706176000 lbs.	5-1000 cps	1-1000 cps	120892571224044677470617600 lbs.	120892571224044677470617600 lbs.
177-241785142448089354941235200	Electromechanical	2417851424480893549412352000 lbs.	5-1000 cps	1-1000 cps	241785142448089354941235200 lbs.	241785142448089354941235200 lbs.
177-483570284896178709882470400	Electromechanical	4835702848961787098824704000 lbs.	5-1000 cps	1-1000 cps	483570284896178709882470400 lbs.	483570284896178709882470400 lbs.
177-967140569792357419764940800	Electromechanical	9671405697923574197649408000 lbs.	5-1000 cps	1-1000 cps	967140569792357419764940800 lbs.	967140569792357419764940800 lbs.
177-1934281139584714839299801600	Electromechanical	19342811395847148392998016000 lbs.	5-1000 cps	1-1000 cps	1934281139584714839299801600 lbs.	1934281139584714839299801600 lbs.
177-3868562279169429678599603200	Electromechanical	38685622791694296785996032000 lbs.	5-1000 cps	1-1000 cps	3868562279169429678599603200 lbs.	3868562279169429678599603200 lbs.
177-7737124558338859357199206400	Electromechanical	77371245583388593571992064000 lbs.	5-1000 cps	1-1000 cps	7737124558338859357199206400 lbs.	7737124558338859357199206400 lbs.
177-15474249116677718714398412800	Electromechanical	154742491166777187143984128000 lbs.	5-1000 cps	1-1000 cps	15474249116677718714398412800 lbs.	15474249116677718714398412800 lbs.
177-30948498233355437428796825600	Electromechanical	309484982333554374287968256000 lbs.	5-1000 cps	1-1000 cps	30948498233355437428796825600 lbs.	30948498233355437428796825600 lbs.
177-61896996466710874857593651200	Electromechanical	618969964667108748575936512000 lbs.	5-1000 cps	1-1000 cps	61896996466710874857593651200 lbs.	61896996466710874857593651200 lbs.



EWN-22 bolt is entirely new. External wrenching head with increased bearing area permits greater loading without distortion of bolt surface. New Hi-Pi thread form, genuine filler under head, smooth overall surface increase tensile and fatigue strength. The EWN-22 locknut was designed with characteristics specially suited to the bolt.



Build stronger, safer, lighter airframes with new SPS Hi Psi aircraft bolts

Conventional bolts were not strong enough to fasten jet-age aircraft now on drawing boards. So Standard Prestressed Steel Co. designed absolute fastener configurations, materials and production techniques and designed a new high-strength bolt—the Hi-Pi EWN-22—which is the strongest bolt made to this time.

Compared with conventional 100,000 psi bolts like the MS 20094 Series, the SPS EWN-22 has 30% greater tensile strength and, at 8 million stress cycles, up to 90% greater fatigue strength. These qualities make it feasible, in most cases, to replace a standard MS 20094 Series bolt with an EWN-22 of the same nominal diameter. The benefits from use of the EWN-22 are increased structural strength and security and its reduced weight—are obvious.

Consistently with the development of the EWN-22, SPS produced the Hi-Pi EWN-22 locknut to complement the bolt. It is a high tensile strength anti-rotating nut with a 12-point external wrenching surface. It makes possible the high wrenching torque needed to preload the EWN-22 to the greatest advantage.

Along with Hi-Pi EWN-22 bolts and EWN-22 locknuts come other new additions to the complete SPS line of threaded aircraft fasteners—PL-22 precision reducing washers, simple mechanical devices for accurately preloading the new high strength bolts. For detailed information about these products—or about your special aircraft threaded fastener problem—write us today. Aircraft Products Division, STANDARD PRESTRESSED STEEL CO., JERISBURG, Pa.

AIRCRAFT PRODUCTS DIVISION

STANDARD PRESTRESSED STEEL CO.

SPS

JERISBURG, PENNSYLVANIA

EWN-22 is much stronger than conventional aircraft bolts. These curves, with ultimate tensile strength in pounds plotted against tensile diameter, show that it is feasible to replace an MS 20094 bolt with an EWN-22 one size smaller. The EWN-22 is stronger in shear and in fatigue as well.

EQUIPMENT

Teflon Hose Use in Jets, Missiles Grows

By George L. Christian

Reinforced, N-J-High pressure—1,000 psi—Teflon aircraft hose is gaining wide acceptance in some of the country's latest supersonic, staggeringly high-mach aircraft and their components, and in some.

Called R700, the hose is produced by Reinforced Nylon Hose Co. in its new plant here. Compared with first R700 is being which sought for use in an aircraft weapon system because it is the first flexible hose to combine high pressure capability with the desirable features to locate in Teflon products: resistance to high and low temperatures, and means to connect easily by virtually any product known, including flaring and white metal ends.

Needed for Heat

R700, which has undergone three years of continuous testing in Reinforced Nylon Hose Co.'s laboratory, also has been two years of actual field service on such jet engines as the J79, J71, J67, J46, and J48.

On all these engines, the hose is used to transmit hydraulic power to the jet, but afterwards cooled acting mechanism. In these operations the hose operates at 3,000 psi and has in continuous temperatures of 500F, rising to 400F during shut-down cool periods.

In addition, in GE's J79 the hose is used in the hydraulic mechanism which varies the angle of the jet compressor stator. Pressure is 3,000 psi and operating temperatures are about 250F to 350F.

As jet planes become faster, heat, which has been confined to the powerplants, creep out of the engines and begins to trouble the whole airplane. One of the first was attacked in the hydraulic system.

For this reason, R700 is used in various hydraulic system test units on aircraft all new supersonic aircraft, plus a number of missiles.

Supersonic Stable

Reinforced Nylon Hose Co. says that in the supersonic stable (which is an air test rig) R700 hose has the entire Century Series Air Force fighters—F 100, J-12, J-14, H-15, H-16, H-17, and the B-70, which, Reinforced Nylon Hose Co. says, R700 extends. Company adds that the Navy's new F-4H fighter's hydraulic system was designed around the use of high pressure Teflon hose. And the

Continued on page 15 in their respective CI-105.

Among missiles using R700 are the Atlas, Redstone II and Thor.

With another use, according to company officials, will probably be in the new Blue Bird Carrier (Navy's latest brought to Capital Airlines). The carrier, which carries the Teflon hose to and from the carrier, runs through the hose to supply R700 hose to British standard.

Use of Teflon hose is not restricted to hydraulic systems. It also is proving to be superior to rubber hose in air bridge control devices such as ejector seats. Because a tube that the Teflon hose tube, unlike rubber hose tubes, does not harden to expand when hit by the sudden rush of expanding gases when the C-42 charge is fired. Result is that a much sharper, more efficient charge is transmitted by the Teflon hose from the initiator to the actuator.

A new age, Wright Air Development Center (WADC) (aircraft development equipment) approved for Reinforced Nylon Hose Co.



R700 HIGH pressure hose being reinforced (left) (hose construction shown) shows Teflon hose tube, first one used, Teflon cover, second one used.

flex hose available to be used with all automatic opening lip bolts in line of the hose assembly then in use. However, the Century specified that, until a Government tested specification was issued and a qualified producer had established, primary contractor, as still required to obtain approval from the Aircraft Laboratory, WADC for the specific use of Teflon hose in a hydraulic system with automatic opening lip bolts.

Making R700

Reinforced Nylon Hose Co. makes double braided R700 in three sizes—1/2, 3/4, and 1—4, 1 and 1 1/2 inch diameter (approx. 100 ft). The compound is what makes hose approximately 10 to 12 (1) in size with high head construction.

R700 is made up of a Teflon inner tube, reinforced by braiding. It is covered with a reinforced plastic outer tube. First used as primary reinforcement. This is covered with a thin Teflon tube to protect the inner hose from atmospheric moisture and to provide a clean surface. The outer band of shrouded steel then is woven on to the whole hose construction to its pressure resistance and permits it from abrasion.

The 1 1/2 inch has an added carbon steel band to give the additional strength needed for the relatively large diameter hose.

Reinforced Nylon Hose Co. says that, at first, they had a slight problem with leakage at the end fittings. They developed a special seal for the fitting which prevented the problem, they claim.

R700 is the first and only hose to have passed all tests in MIL-15512 with the temperature range from the standard 120F—down to 400F, according to Reinforced Nylon Hose Co. The tests were conducted with last month by WADC's Aircraft Laboratory at 4000 and 5000 psi. Company points out that passing these tests does not mean automatic approval of the hose because no specification (1) exists for such tests at the temperatures indicated.

Reinforced Nylon Hose Co. says that R700 hose is used by companies as late as 1958 with lots of evidence. Company believes it will be able to run the temperature, heat to 550F. Plus, on one order so far to supply the base for Class 4 hydraulic system which has a temperature limit of 150F.

As company engineers point out, if R700 will operate satisfactorily for 50 years at 150F, then it may operate about 100 ft of one-day operation, then only

UPPER ATMOSPHERE
RESEARCH

The International Geological Year is a period of intensive research devoted to the earth and its surroundings. Aangst Gansel researches earths and physicaal geologie at IGT in addition to Project Vangard geothermal systems. Aangst will supply oil-fueled Aardbe in rockets for orbital research (left). Inge Røed (top)



Whether you intend to use Vanguard or not, you will find that the Vanguard website is a treasure trove of information. The site is easy to navigate and provides a wealth of information on a variety of topics, including investment strategies, market news, and company performance. The site is also a great resource for investors looking to learn more about Vanguard's products and services.

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Wicks, Director of Scientific and Engineering Personnel, Box 2048, Azusa, Calif. or Box 19479, Sacramento, Calif.

a sense of a total spending life will be spent on extraordinary speed and flourish, but And so in my be the essential life span of the audience.

In at least one engine application, E700 has operated satisfactorily for four hours at an ambient temperature of 750°F with 4350 fluid running through it. Knowledge officials claim

Computers also plans to test R700 to 2.0GHz.

Purpose is to determine whether the home will withstand 4,000 psi and, if so, for how long.

Point of Controversy

AVIATION. With a series of high pressure Teller tests uncovered a controversy concerning the construction of large-scale (about 8 m) bombs.

Resistor believes that its standard, double-braided construction will open its satisfactorily under the impinging inherent in 1,000 psi aircraft fuselage outflow. The company's double-braided hose is being today in sizes -4, -6 and -8. The -12 size also is being in Comair's B-18, but that hose is being

Designation Change

Reynolds is dropping the Y prefix on its YR700 high pressure hose on the -1 and -4 sizes since the company feels that these two sizes have been fully proven. The Y will be dropped from what high pressure hose size male is made as well as supplying a test program comparable that given to the two smaller sizes. However, the Y designation will continue on any size hose if a customer has inserted the letter into his specification.

loaded and its operating time is limited.

Aerogrip Corp., Jackson, Mich. designs a company official told Aviation Week, that starting with the -8 size (possibly with the -6) and larger, available and even tape-based construction will not be satisfactory. Reason is that bending the steel wire crimps them and the expelling of the lubricant causes fluid under 5,000 psi to escape.



Fuel Cell Development Lab

This hot and cold room is part of a new \$4 million soft soil development laboratory recently completed at B F Goodrich Company's Los Angeles. Cold plant. Photo shows a technician working in Room B-52 and soil structure is preparation for hot and cold tests which are conducted at temperatures ranging from 165F to -25F. Hot and cold rooms is designed to test the rubber and rubber-like materials used in fuel cell construction. Other test facilities in the lab include an air transfer

old chambers for development testing which can be brought to +1000 to cool feed. Equipment for the ocean includes a closed static capable of handling +10,000 to load for testing the ability of fuel cells to withstand fuel surge pressures, a vibration table capable of vibrating 2,000 cps at an amplitude of 1/2 of an inch, a variety of ocean and flex testers and laboratory ovens and other equipment to evaluate performance of new materials to 5000° F. Facilities test high energy fuels.



Globe Aerostatique...1783

Montgolfier's vanguard project

A sheep, a duck, a rooster—the first payload carried aloft for atmospheric research. Louis XVI, his queen and his court, were astonished witnesses as Joseph Montgolfier's smoke-filled balloon rose in majesty 1800 feet over Versailles. The passengers? Unbanned! Fear not the rooster, killed by the sheep!

Project Vanguard, 1957, is an equally momentous "first"—an attempt to place a 21-pound satellite in an orbit 300 miles up. Aerojet-General, designer-builder of the famed Aerobee-H, will supply vital second-stage propulsion systems for Vanguard launches during the International Geophysical Year.

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Vickers Servo Pump Systems

Provide rapid and accurate response to minute electrical or mechanical signals

The Vickers Servo Pump Unit shown at the right is a signal-controlled, variable delivery, pressure-compensated, reversible, flow oil hydraulic pump. In combination with a rotary or linear hydraulic motor, it forms a signal-controlled hydraulic transmission for remote control operations and high-pressure servo systems.

The servo transmission may be considered as a power amplifier when viewed from the electrical signal aspect, of about five to ten; as a mechanical power output of several thousand watts. Various sizes of transmissions have been built, having output capacities ranging from one to four hundred horsepower. The servo pump develops only that pressure required to move the load, which means reduced pressure over the greater part of the system load range. Load action only indirectly enters the equation of system. This greatly reduces power losses and maintains low rejection.

Any type of prime mover of sufficient capacity can be used to furnish the power input. Electric motor, internal combustion engine, turbine, hydraulic motor, the substantially constant speed is desirable.

Variable Pump Volume Controlled by Signal

Heart of the servo pump unit is the Vickers Variable Stroke Hydraulic Pump. This is usually a non-reversible pump, based on a mechanical signal. Varying the stroke angle varies

piston stroke, hence output volume flow rate in proportion to either direction of stroke. Stroke position attained by a pilot valve varies the stroke angle according to signal.

Low Control Power Requirement

Power for control purposes is low as a servo pump unit becomes metering valve means is controlled by the voltage-transducer signal which is a low power level (100 to 300 psi) hydraulic stream separate from the power transmission hydraulic stream which is part of the pump unit. This voltage-transducer signal controls piston displacement and direction in the power pump which can operate at pressures up to 3000 or 4000 psi. Pressure drop across ports of a metering valve, with an adjustment valve, is avoided in the power transmission system. Total power output from the pump is determined by the volume of flow which the voltage-transducer system demands and by the actual resistance of the load — it is not dependent upon pressure drop method of control.

In a control system employing the servo pump, the variations in gain resulting from load change are negligible compared to those which may occur in a similar system controlled by a valve moving directly in the power line.

Constant Displacement Hydraulic Motor

This unit is a transmission generated in the hydraulic pump are control by varying

with no intermediate valve in the hydraulic motor or linear actuator. The fixed stroke hydraulic motor provides output directly proportional to pressure and speed directly proportional to flow rate.

High Power-to-Weight Ratio

The servo pump unit and its associated hydraulic motor are designed for high power-to-weight ratio, high torque-to-inertia ratio, low inertia of rotating parts, and high resonant frequency.

Typical Example

High power to weight ratio—3.5 hp (gross only) per total gross weight—2.5 to 3.0 hp/gross lb. for motor of rated pressure—1000 psi.

High resonant frequency—30 cps (rated system)

Only advantages are reliability and versatility of application. The reason,



replaces speed changes and ability to load position against any variation in load are additional reasons why this unit is a desirable resource which can solve many design problems.

Important aspects of the application of Vickers Servo Pump Units is an extremely fast and accurate positioning of mass mounted on aircraft. Another is the use of the unit as a power amplifier where the servo pump is characterized of producing at all times only sufficient power to meet the momentary demand, maintains the power line and therefore the best response. The greatly reduced average pressure level in this type of system prolongs the life and improves the reliability of all components.

For further information, ask for Redfords SE-15 and SE-16 or get in touch with your nearest Vickers Aircraft Application Engineer. He can arrange for an engineering team to consider your problem and present an optimum solution.

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Teflon Troubles

Remember which developed its own method of treating Teflon into reinforced hose in a product called Teflonex 7, was faced with a problem in November, 1955 when its existing facilities failed producing less than its initial amount of hose. Production was shut down from November, 1955, to February, 1956, while the trouble was traced and resolved.

Dr. Paul Grosvenor fixed the blame on one of the new methods for the Teflonhosehose line. Essentially, the fault of the incident lay in its being made worse than before.

the wires to hang together, bend and break. Also, their bending loss is heavy, bulky and stiff.

Aerogrip is departing from the traditional braiding reinforcement and will use a special steel wire construction which avoids the overlapping wires and resultant potential breakage. The company has a 3-5 sec, high pressure, high temperature heat setting the spiral reinforcement and test is its failure series. It believes that this construction is far superior to conventional braiding in its resistance to acoustic fatigue. Tests with the hose are scheduled to be completed about the end of April.

Spiral Construction

Remember it watching the spiral, or wound wire, construction. Company engineers are finding that type of construction with conventional braiding, they are not sufficient problems of wire separation which will allow the wires to slide outside through the gap. Also, they believe that living attachment will pose problems.

Aerogrip says that it is in production on —4 and —5 double-headed high pressure, high temperature Teflon hose braiding in a laboratory at their small size. The —4 has been scheduled to WAFG for test, the —5 has not. Operational aircraft using the hose is Convair's F-102A, according to Aerogrip.

The hose is extruded and laminated for the company by Electric Hose & Rubber Co., Waukegan, Ill., and does a fine job, says Aerogrip. Aerogrip cuts the hose into desired lengths and attaches its removable Super Gase fittings to the hose assemblies.

Teflon, i.e., Springfield, Mass., which Mr. Grosvenor, extruder and braider's own host, is developing a 3000 psi hose. Company says that its development is not advanced enough to determine what type of construction will be used.

Remember, which developed its own method of extruding braiding the high



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WELDING PROGRESS REPORT

Leading Aircraft Subcontractor Proves Job Shop Economy of Sciaky Counter Weld Control

Electronic Welding Company of Los Angeles, California, has now completed over eight months of production experience with the new Sciaky Prodeserv® Electronic Counter Controlled Resistance Welder. Their experience points out the advantages of the new Sciaky welder already proved in high production service apply equally to "job shop" requirements.

Ease of Set-Up Is a Key Factor

Mr. George Palmer, President of Electronic Welding Company, sums up his experience when he says: "The new Sciaky welder enabled us to gain in a definite advantage over the R.C. tracer. We got normal ease of developing and repeating a weld schedule, including those requiring carbide-tipped electrodes with MIPex®."

Versatility Is Vital for Job Shop Operations

The versatility of the Sciaky Prodeserv Electronic Counter Controlled Welder makes it the logical answer to Electronic Welding Company's requirements. Sciaky set-up minimizes the need for hard-to-get skilled labor. Its versatility for aluminum, steel, stainless, jet engine alloys, brass, etc., makes practical the use of the machine on both aircraft and non-aircraft work.

At Electronic Welding Company, a single Sciaky spot welder is now set for work on the J-57 program and five engine subassemblies in the F-334 and B-52 programs. Current usage is two ten hour shifts per day.

Mr. Palmer states that "having a Sciaky Prodeserv Electronic Counter Controlled Welder is almost prerequisite to getting subassemblies done airborne and yet require synchronization and endurance con-

ditions as well as their commercial manufacturers to require the highest standards of weld safety and economy."

To prove his confidence, Mr. Palmer has placed orders for two more of the new Sciaky Welders. One is a spot welder, the other a seam welder.

Production Advantages

Important to all who require safe, economical work is the precise control provided by the new Sciaky Welder. Users report that they get

precisely what they set on the welder. The machine can not deviate from its setting and it is consistent throughout the entire range of adjustment.

Another advantage is the versatility of maintenance. Plugs and seals assembly control units make it possible to replace a unit in a matter of minutes. Further, the plugs feature permits easy addition of additional functions if they are ever required.

Literature Available

Technical bulletins completely describing the new Sciaky Prodeserv Electronic Counter Weld Control are available. Write us your company letterhead requesting Bulletin 335 and 339. There is no obligation.



ELECTRONIC WELDING COMPANY'S new Sciaky Counter Control Welder. It is shown here welding an substructure from the Pratt & Whitney J57 jet engine. Note the production use of a blank resistance welding rod.

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Teflon Toxicity

Teflon has been accused in some quarters of posing all time hazard when heated to temperatures over 400°F. Research offers these comments from Wright Air Development Center, Aero Medical Laboratory.

"Toxic information received as WADC Technical Report 54-361, Teflon does not pose all time hazard at low pressures below 300C (571F) but a toxic at temperatures above 370C (700F)."

genuine Teflon hose, has received R. F. Goodrich's endorsement. The product

Flex-O-Tite Insulator-Mech has been licensed in Resinoid to make fittings for the hose and is in production on the smaller size using Goodrich hose.

Stratford, Inc., Fort Worth, Texas, also will produce assemblies using Goodrich hose and its own fittings, according to Resinoid.

At the present state of the art, the former appears to be limited to hose material when temperatures exceed about 550F. Resinoid officials concede. The only substitute on the horizon appears to be rapid metal tubing apparently limited to limited to allow a certain amount of flexing between the two ends.

Resinoid, which already performs much metal tubing for its current hose assembly, is studying its interest in this type of planning.

Resinoid fittings have these three advantages when used with relatively inexpensive rubber hose:

- Fittings, being the most expensive part of the assembly, can be used and reused when the hose wears out or breaks.

- Fittings can be re-used when rubber hose, because of its limited shelf life, has to be discarded.

- Logistics and maintenance problems are greatly simplified because hose and fittings can be sent into the field in bulk. Hose can be cut to length and fittings assembled in serial order, of buying in ship and stock large quantities of assembled hose assemblies of various lengths.

All this has changed with the advent of Teflon hose says Resinoid. Here is why:

- Hose rather than the fittings, is now the most expensive part of the assembly.

- Hose made of Teflon has indefinite shelf life in several kinds to be discarded.
- Permanent assemblies are required in more cases by repair manufacturers who want to eliminate the possibility of in-the-field servicing in unprepared personnel.



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Ram air compressors. Two small compressors driven by single motor are installed in an altitude simulation aircraft plant. Allis-Chalmers builds all sizes of axial compressors for small or large wind tunnel installations and other applications.

Altitude simulation and component testing with vacuum pumps. The long line of single-stage rotary units is installed in an altitude test laboratory in the Midwest.

ALLIS-CHALMERS



CAA Evaluates Lights To End "Black Pit"

Andrews AFB, Md.—Exhaustion tests at high density runway lights conducted by Civil Aeronautics Administration Administrator James T. Fyle in the "ground component of an all-weather navigation system" will be completed May 1.

In a most series of simulated IFR approaches and landings conducted with Fyle at the controls, three types of runway lights designed to eliminate the "black pit" illusion were demonstrated.

Experimental flights using the three types, all of which are produced by Sylvania Electric Co., began last January following the making operation of the system. Decisions as to which of the three systems will be adopted will be made by CAA around May 1 after air comments have been evaluated.

Three Configurations

Two of the systems differ only in configuration.

• First type consists of Elikas bars of light set back along the foot 5,000 ft of runway at 100 ft intervals. The outer lights are located 70 ft from the runway centerline.

• Second type calls for an arrangement of the same number of bars 45 ft from the centerline.

The Elikas runway lights were originally developed by the Dutch and have been in regular use at Andrews' Selfed Airport since 1955 (AW Jan 18, 1955, p. 21).

In first arrangement, each fixture is mounted in a box that is oriented with a protective grid and buried flush to the runway surface. The experimental lights in the Andrews Field installation are not yet flush but are set so top of the runway surface is about 100 ft from three fixtures that simulate the flush at runway.

The third system at Andrews includes a 75 ft continuous strip of very high output fluorescent tubes on either side of the runway, beginning 75 ft from the threshold.

The lights form the complete runway surface and pack up strip markings at runway end and alternate white crystals.

This system has not yet been thoroughly tested under simulated conditions, and there is some question as to whether glass against fog may eliminate it as a possibility.

The fluorescent tubes have a 410 volt, three-phase power requirement. Each tube is a 400 watt tube, 25,000 candlepower is produced by each eight ft. length of the system. Total consumption is 70 kilowatts.

CAA believes that this type of runway light will be effective only on a black asphalt paving since reflecting glass may be indicated by white contrast.

Chief advantage of the system is that only slight runway modification is required for installation.

Elikas Installation

Reduction of the Elikas lights probably will be confined to new runways since installation of the unit in present runways would call for much heavy construction work in laying the power lines and affixing the buried box units.

The Elikas light is a 250 watt, PAR

34, 128 volt lamp. One lamp is located on each unit which, for replacement purposes, contains ballast to provide a critical beam and specific intensity curve.

James Harding, project engineer of CAA's Technical Development Center in conducting the tests. Administrator Fyle says he is convinced that CAA has "the answer" to the "black pit" problem in any of the three lighting units. He added that an improved landing system that provides a more accurate glidepath in automatic ground control approach, will permit the CAA to eliminate the 200 ft. one-half-mile visibility minimum at airports where the best of these systems is installed.



ONE SYSTEM of runway lighting lights under test by CAA has been spaced 50 ft from runway centerline. In operation, too, lights would be set back in runway.



SECOND SYSTEM is similar except that the bars are spaced 45 ft from runway centerline. Produced by Sylvania, the Elikas runway lights originally were developed by Dutch.



THIRD SYSTEM consists of fluorescent tubes with high output along runway edge. Light reflects on painted strip, but is better on black surface than shiny surface.

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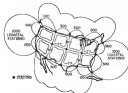


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SPOKEY CYTAC, a low-frequency, high-accuracy phase-comparison Loran, needs only 15 stations to blanket U. S. and adjoining areas. **Fig. 1** shows (left) adequate probable error in first North Atlantic coverage (right) would require only eight Cytec stations.

Cytac Makes Bid as Navigation Aid

By Philip J. Klass

New York—Cytac, an extremely accurate, low-frequency hyperbolic navigation system has shed its security wraps to bid for adoption as an international long-distance navigation aid. That puts it in competition with the British Decca and Decca systems, the French Radio-Web, and the Norwegian

which the Air Commanding Committee adopted as the official U. S. copy. Sperry Gyroscopic Co., which developed the system under USAF sponsorship, also views Cytac as a possible first Government System replacement for Vortac because of its high accuracy and low-altitude coverage.

Fifteen Cytec stations could blanket the U. S., portions of Canada and Mex-

ico and 1,000 miles not in use in other areas. Accuracy could decrease their position with an error of no more than a couple hundred feet anywhere in the area, a Sperry engineer told the recent Institute of Radio Engineers convention (See sketch above).

Two chains of four Cytec stations (right total) could provide coverage of the North Atlantic with at least a 10-fold improvement over existing Loran stations, Wendell Palmer reported. (Palmer told a paper prepared by WVO but P. D'Amico, one of three guests by Sperry engineers at the Cytec system.)

LF For Common System?

Despite the heavy U. S. involvement in present very high frequency (VHF) Vortac dual-frequency navigation system at least a few navigation traffic control experts are taking a fresh look at low-frequency hyperbolic navigation systems as a possible future replacement for Vortac. This includes such systems as Cytec, British Decca and the French Radio-Web systems.

This most appear aimed at Europeans who regard the adoption of such systems 30 years ago when the U. S. was pushing VHF dual-frequency navigation into the international category.

Reasons for the re-examination of LF navigation systems include:

- Low altitude coverage for helicopter service is available from LF aids, not from VHF systems.
- Worldwide area coverage available from LF system would permit a few stations to blanket the U. S. whereas more than 1,000 VHF stations will be required for the same coverage.
- Higher accuracy generally is available at greater distances from the station, providing closer spacing of aircraft, thus with the facts low-flight system.

There were some of the points made at the recent IRE convention by Vernon White of the Air Transport Association and NADSA.

However, there are two important disadvantages to most existing LF systems.

- Susceptibility to atmospheric disruption due to adverse thunderstorm activity, whereas VHF is perfectly immune to such disturbances. Reliable navigation service is most needed during weather conditions.
- Weight and size penalty of airborne equipment, particularly for the private flyer whose crowded with weight and size of his present VOR receiver.

Assessing the vulnerability of LF system to atmospheric disruption, White suggested the use of a small lightweight automatic dual receiving computer to supplement the LF system. Such a device could provide continuously accurate navigation information in clear periods when LF service was disrupted, could be periodically rechecked for drift errors when the LF signal was available.

Pulse, Phase Comparison

Cytac might be termed a low frequency Loran system with phase comparison added. A Loran type chain of stations transmits a series of pulses at standard Loran repetition rates (50 to 500 times per second). To obtain greater accuracy in determining the time between pulses arriving from individual stations in the chain, Cytac measures the relative phase of the radio frequency carrier in these pulse code units. This improves accuracy by a factor of 10-20 over standard Loran, according to Sperry engineers.

Cytac achieves considerably greater range than standard Loran because it operates at 100 kc. instead of Loran's 2,000 kc. frequency. Compared to Loran's distance range of 700-800 miles over water, 200-300 miles over land using ground wave signals, Cytac provides a usable ground wave signal out to more than 1,000 miles. Distances reported. Loran range goes up to about 1,000 miles at angle using skywaves that bounce off the ionosphere, but

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do more operation (produce) operation policy and require that each landing be compensated for the longer do more operation path. Cyclic, which operates solely from ground waves, does not encounter this problem.

Cyclic originally was called Cyclic, a contraction of Cyclic-landing. Later, "Why is development was later indicated toward possible use by the United States Coast Guard, the name was changed to Cyclic.

If the USAF has plans to make tactical use of Cyclic, there have not been disclosed. Agency holds a contract to set up a Cyclic chain along the East Coast which will be used by the Coast Guard and the Navy for undisturbed personnel. Like Loran, Cyclic can provide navigation service in either ships

Airborne Equipment

In late 1967, the Navy's only experimental Cyclic receiver which indicated classified features are required for civil use. Future estimates that as far more money for civil use capable of automatically providing accurate position fix data, can be built to weigh 40 lb. Such a receiver could not directly in direct aircraft position. Pilot would have to read two different numbers, then refer to special Loran type charts to determine position fix. However, for an additional 20 pounds, automatic plotting and display of aircraft position could be provided. Future estimates

For domestic Coast Guard systems applications, aircraft operation probably would mean upon the fully automatic display position. This would give Cyclic at a moderate weight disadvantage compared to present airborne VORTIC equip-

ment (including DME sensors), and at a sharp disadvantage for greater than who are only a 10 pound VORTIC receiver. Polaris says it may be possible to build a lighter weight Cyclic receiver for private Navy with somewhat reduced accuracy, but gives no weight estimate.

Loran, Cyclic Fundamentals

Both Loran and Cyclic operate on the basis of the following principles. If two ground stations transmit a pulse of radio energy, followed by a fixed and known time interval (T) later by another pulse, transmitted from a second ground station located same distance away from the first, then the two pulses will be received by a receiving vehicle with the same time spacing (T) if the vehicle is located at an equal distance from both stations.

If the vehicle is closer to the first station, called the "master," the time interval will be greater (T + ΔT) if the vehicle is closer to the second station, called the "slave," the interval between pulses will be less (T - ΔT). By measuring the spacing between the two pulses and comparing it with the known spacing at the time the pulses were transmitted, the receiver determines the vehicle's line-of-sight position. A hypotenuse is drawn from whose focal points are the two stations.

If another pair of master pulses are transmitted by a second pair of stations at least one of which is in a different geographic location from one of the first pair, the time interval between receipt of these two pulses establishes a second line of position.

Intersection of these two lines of position on a Loran-Cyclic chart represents

the vehicle's position. If a third pair of stations are available, they can provide a third line-of-position to double-check the vehicle's position fix.

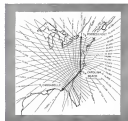
In practice, a single master station and two, or three, slave stations are frequently used instead of two or three distinct pairs of Loran or Cyclic stations. In such case, the master station after each takes up with each of the slaves to transmit a pair of pulses, at a time interval equivalent to a single master-slave spacing.

Pulse Spacing Measurement

One of the major limits on the accuracy of standard Loran is the pulse rate with which the time spacing between pulses can be measured. Because the pulses may be distorted when received, it is difficult to determine the time interval more accurately than to define one standard pulse. It is impossible to give the equivalent position fix error as fast to make sure they will depend upon the configuration of the Loran chain and the vehicle's position relative to the stations. The NAC report says that typical Loran errors in distance (using ground waves) average about 15 meters (nearly one nautical mile).

The problem of measuring pulse spacing is more difficult at night when skywaves, resulting from earth-to-sphere reflections, may produce a shadow of up to 20 spurious pulses which can overlap the actual pulses from a subsequent ground station transmission. The case issue considerably higher errors in measuring pulse spacing. NAC's report says that average about five nautical miles.

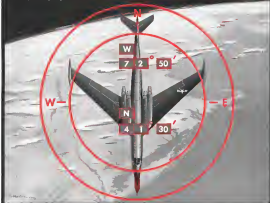
Cyclic, like standard Loran, requires



HYPERBOLIC CYTAC system, an experimental cost cost installation (left) produced errors well within estimated values (right). Small figures denote travel time from estimated error in feet. Actual error experienced are shown at locations received.



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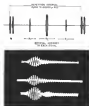
Instantaneous in operation, the Ryan navigator gives the pilot his position (latitude and longi-

tude), ground speed, ground mileage, drift angle and ground track in continuous, readable form. No computations are necessary. The equipment is compact and self-contained. No ground facilities are employed—no wind information or windage data are needed.

This significant contribution to jet navigation is typical of the work which Ryan and the military services are accomplishing in other fields of electronics research such as supersonic missile guidance for the Air Force and helicopter hovering devices for the Navy.

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CYTAC PULSE sequence (right) illustrates conventional Loran. Waveform is received at Chatham, N. C.; does represent Cytec data as shown below.

that transmission time of each station-sensor combination be understood to derive constant and known spacing between their pulses. Cytec, in addition, requests that the respective RF carrier of the two stations also be synchronized. Synchronization is accomplished by ground-wave signals to base monitor and slave station.

The Cytec receiver receives pulse spacing in Loran-form to obtain a rough indication, then polishes it off precisely by measuring the relative phase of the RF carrier of the master and slave pulse envelopes. The rough pulse spacing measurement it made with sufficient accuracy to permit ambiguity in the phase comparison process, or to prevent comparing phase of the first cycle of master pulse with the second cycle of slave pulse.

By combining pulse and phase comparison techniques, Cytec is able to measure pulse spacing to within 0.01 6.85 microseconds, according to Palmer. Cytec's measurement error is only a fraction of the total system error, the bulk of which results from variations in the velocity of radio wave propagation due to changing weather conditions. Sperry's Walter N. Dean told the TRF: "With suitable compensation for the latter, Cytec's overall timing error are about 51 microseconds, compared to one microsecond for a standard Loran."

Sky-Wave Contamination

Sperry's tests indicate that the operating range of a single Cytec chain could be extended from 1,930 to perhaps as much as 2,500 miles if sky-wave noise and "haze" of the system is designed to operate with ground waves under normal conditions to avoid contamination from spurious pulses. The first of any sky wave pulses near



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usually arrives at least 30 microseconds after the corresponding ground wave pulse. To avoid any more confusion, the Cytac system is designed to provide a full-wave pulse whose amplitude is sufficient to permit phase comparison of its carrier to something less than 30 microseconds.

Is an experimental Cytac chain covering the Eastern half of the U.S. Sperry sent pulses which rose from sea level full amplitude in about 30 microseconds, with the receiver designed to perform the phase-comparison approximately 25 microseconds after the start of the pulse.

At the low frequency at which Cytac operates, fast rising pulses mean radio headwinds. Cytac occupies the full 30 kc. spectrum allocated in the 90-130 kc. band for navigation purposes, and about one per cent energy spills outside band.

Some engineers believe that the 20 kc. bandwidth requirement will make Cytac receivers extremely susceptible to atmospheric disturbance from Florida to Alaska. Nashville, which also operates in the vulnerable 100 kc. region, is designed to use extremely narrow-band techniques (AW Apr 26, 1954, p. 52). However Sperry engineers on that score think a lot of money is the expense of Cytac installation resulted in a great outage.



Block diagram of Cytac receiver.

A major source of error in the Cytac system arises from RF carrier phase shift due to different ground conductivity over different portions of the path between receiver and ground station. Sperry found errors as large as 54 microseconds. Interference also had a marked effect on apparent propagation velocity, particularly in the winter. Dorn told the IRE.

Phase shift due to different ground conductivity appears to remain reasonably constant, showing a variation of less than one part in 10,000 over a period of a year, Dorn said. This suggests the possibility of mapping the Cytac service area to determine a large



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ground conductivity, which is critical when determining the Cytac charts to use specific for them. Dorn said.

Sperry tests also indicate that phase shifts due to temperature changes are minor or less linear along the propagation path. This opens the way to automatically adjusting the true-air-speed between tracks and phase station pulses to partially compensate for temperature phase shift.

Dorn concludes that "it is possible to reduce greatly the long-term variation in propagation time making feasible overall accuracy of time difference determination to the order of ± 0.1 microseconds."

Short-term variations, due to atmospheric noise and interference, are now tolerable, smaller than those encountered long-term variations, Dorn said.

Time-Sharing Receiver

The repeated nature of pulse signals from different stations in a Cytac chain permits extensive use of time-sharing within the receiver to reduce size, weight and complexity, Sperry's Robert L. Frank told the IRE.

For example, a common RF amplifier is used, supplied with a time-shared automatic gain control (AGC) voltage. This equates signal amplitudes, and phase measurements are made almost independent of 30 microseconds between all signals pass through the same circuit. Frank and Younger mention also are shared.

New VHF Receiver Weights Only 10½ lb.

Cyber Japhet, Ives—New lightweight VHF communications navigation receiver for airline and business aircraft use, which weighs 10½ lb. receives a short 2 ATR mac rate and provides 90 kc. channel spacing over the frequency band of 105 to 112 mc, has been announced by Collins Radio Co.

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In addition to providing constant output service in the 100 to 352 net band, the STX-7, when used with a Collins 344B-1 frequency synthesizer, now accurately tunes combined to a short 4 AVR and weighing about 12 pounds), provides:

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- **Omniwave** (VOR) service, between 112 and 115 mc. with voice reception
- **VOR** service at even tooth-ratios, and odd 50 kc steps from 305 to 111.9 mc. with voice reception

The STX-2 uses 45 crystals for the full 100 to 352 mc. coverage but can be supplied with fewer crystals if only 106 to 136 mc. service is required. The receiver is designed to American Radio Inc. (Cincinnati 1244 and England) modular construction throughout.



► **Collins Spoken FWH Research**—Two research developments in the design phases of the aircraft primary waveguide antenna problems have been licensed by Collins Radio Co. at several universities and research centers.

► **New Type Amplifier**—Construction of two solid-state, plasma-coupled, transistors and photomultiplier tubes provide an interesting new technique for controlling flow of electric current, according to Dr. Mikhael El-Halla of General Electric Research Laboratory. Some semiconductor processes emit light when current is passed through them, light which could be converted back into electrons, which is utilized in amplifying photomultiplier tubes. Another method is to use the same conductive metal plate and grid electrode. El-Halla also speculates that semiconductor particles light waves might be "the key to getting closer to the theoretical 200 billion times more efficient than the best of vacuum tubes."

► **Changing Times And Names**—Radio-Electronics-Television Manufacturers Association (RETMMA) has now changed its name to Electronic Industries Association of Electronic Manufacturers Association. Originally called Radio Manufacturers Association, the



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Illustration shows sand casting process for valve casting

This extremely complex aircraft valve body is currently being sand cast by Rolle in two aluminum alloys, 3557G and 3597G. But as part of a continuing program of casting research, Rolle has also poured the piece with equal success in ZRE1 and A-142. While A-142 does not yet have the acceptance of many other alloys, Rolle is extremely interested in its possibilities in high temperature applications.

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is second in command of the Marquardt engineering-production team. With an engineering-business administrative background and more than 20 years' aerospace experience in the aircraft industry, Bob is one of the motivating factors in the rapid strides being made by the Marquardt team.



Engineering Management—An engineering-management team, comprised of some of the country's recognized specialists and technical personnel in the field of supersonic propulsion, stimulates Marquardt's progress.



Research and Development—The West's largest rocket test facility, situated at the Van Nuys plant, provides professional engineers with the tools to test advanced designs and development ideas.

Marquardt's new production facility now under construction at Ogden, Utah

offering new opportunities to professional engineers

Freedom to pioneer—freedom to grow—these are the challenges and new engineering opportunities at Marquardt Aircraft.

Through these freedoms, Marquardt stands established as the leader in ramjets, "powerplant of the future."

Through these freedoms, Marquardt leads the way into advanced engineering projects.

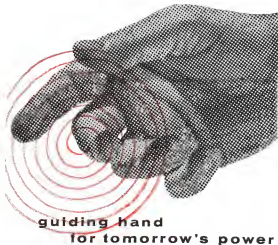
These freedoms—pioneering and growth—see as individual as each professional engineer, as collective as the entire Marquardt team. Through them, Marquardt now offers new and unlimited opportunity for professional engineers in two of the West's most stimulating areas. At Ogden, Utah, is the heart of the Wasatch Mountain ranch area, Marquardt is now constructing a multi-million dollar production plant to produce supersonic powerplants for the Boeing B-70 intercontinental missile. And in Southern California's San

Fernando Valley, Marquardt professional engineers are involved in a major expansion program for design, development, and test of new ramjet engines, turbojet and ramjet engine controls.

If you are a professional engineer interested in the freedom to pioneer—the freedom to grow—for yourself and your company, we invite you to investigate the opportunities at Marquardt Aircraft, today. Please contact Jim Dale, Professional Personnel, 16551 Santee Street, Van Nuys, California.



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Skilled hands coupled with keen minds made today's rocket powerplants a reality. Minds that formulate new theories in powerplant design... and hands that prove these theories by careful experiment, test and application.

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Engineers, Scientists—Perhaps you, too, can work with America's first rocket firm. You'll find the problem challenging, the rewards great.



Portable PA

Portable broadcast public address system, delivers 34 watts meter power, weighs only five pounds and operates from eight flashlight batteries. Drives two ranges of more than 400 yards under reasonably quiet conditions according to manufacturers, East Electronic Corp., 2995 Middlefield Road, Palo Alto, Calif.

name was expanded when TV arrived on the scene. With the rising importance of the radio and industrial electronic segment of the industry, it took its present name.

► **Beaull**, Eastern Bay Flight Director—Coffin Rodin's newest Model FD-115 flight director system will be installed on Eastern Airlines five new Boeing 707s and nine Lockheed Electras and on Eastern Air Lines' 24 Douglas DC-8s and 40 Electras. New model has four-axis character panel indications.

Microwave System Uses Tropospheric Scatter

Tropospheric scatter communications system which operates at microwave frequencies (1.315 to 5.580 mc) tested at the Naval RHB base, thereby making system less vulnerable to enemy interception and, in disruption, has been developed by Philips Corporation for the Air Force. System provides radio bandwidth for transmission of television or radio signals over distances up to 300 miles.

System employs two 25-ft. parabolic antennas which provide a 54 db gain and 0.5 degree beam width. This provides extremely high directivity which makes transmission less susceptible to interference from aircraft or on near the beam.

Also used are two four-cavity klystrons amplified rated at 2,000 watts continuous power and a device which combines the output from two diode rectifiers without previous switching to prevent problems to provide a 3 db gain in performance.



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Dr. Ellis Conner, head of the Propulsion Department, discusses methods of accurate thrust measurement for a helicopter rotor with Dr. Howard M. Kaufman (left), propulsion staff engineer, and Andre P. Biquart, propulsion research specialist.

PROPULSION ACCURACY—a major missile problem

Controlling power action is but one of the major problems facing propulsion engineers and scientists. Important advances in this and related areas of propulsion are necessary to insure systems now in development.

Because of the growing complexity of problems now being approached, Propulsion Engineers find their field often virtually limitless scope for accomplishment. The ability to perform precise work is essential.

Engineers and scientists possessing a high order of ability and experience in propulsion and related fields will be interested in new positions now at Lockheed Missile Systems Division's Sunnyvale and Van Nuys Engineering Centers. Inquiries are invited.

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MISSILE SYSTEMS DIVISION

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BUSINESS FLYING

New York Police Helicopters Save Lives

By Evelyn J. Reisman

New York—New York Police Department helicopter operation underscores the value of rotary wing aircraft as an effective life saving and law enforcement medium for local government.

Scores of lives have been saved thus far by Bell 47 Ds belonging to NYPD's Aviation Bureau. About a dozen drowning persons were rescued last year alone. Helips published in the local press, NYPD's little Bells are almost as familiar in local New York as the department's ground-based patrol cars.

High Record

Although the Bureau's modest \$25,000 annual budget hasn't been increased over the past five years, wise selection of the high record held by municipal officials for Aviation Bureau operations can be seen by the next test: most of budgets get during annual review compared to other roughly funded city departments. When NYPD's Aviation Bureau decided to acquire with modest means, it carried out approval necessary to purchase three new (and older Bell 47 J) Rangers. Standard price for the 47 J is approximately \$60,750. With all of the equipment specified for the Bureau, its aircraft will cost approximately \$68,000 each, including rotor, rotor blades, accessories, power hose, approximately \$2,000 worth of radio and spares.

Normally Bell recommends that purchasers of a single 47 J get 52,000 in spares, but ships' clients have 52,000 worth and three would require 576,000 worth. This is based on a single test, or 600 in operation. Bureau is fortunate that some 75% of its 47 Ds spare one service for 47 J operation, while from engine and rotor blades.

First Delivery

First of the Bureau's three Rangers was delivered late in February; the other two were scheduled to be delivered at Ft. Rucker North Field base in Florida this month. Of its two remaining 47 Ds, one will be used for training and the other eventually will be replaced with a new model.

Ranger's improved performance with increased payload and the more factors in reducing the air search. Although the 47 D is rated by the manufacturer as a three-place Aviation Bureau says, order of a two-place ship for its type of operation. Its new Rangers with a one seat allowable gross of 2,565 lb., pro-



FIRST OF THREE Bell 47 J Ranger helicopters purchased by New York police.



NEW MODEL will replace Bell 47 Ds. Department will keep two 47 Ds.

vide a payload of approximately 550 lb. permitting a good combination of rescue operations and sports duty roles to be carried. Payload maximum to about 1,100 lb. may be variable, with Bell working to increase the 47 J's allowable gross weight to approximately 2,000 lb. Aviation Bureau's heart is along the rotor stretch of motor coaches. New York City, purchasing some 600 in of helicopter. It works with Civil Air-

marines Administration and Civil Aeronautics Board in checking compliance against law. Emergency operations all Department of Marine and Aviation regarding airplane laws and other landing areas in its jurisdiction, and does a considerable amount of aerial rescue for various City departments.

An average unit's breakdown of the type and number of flights in helicopter units include checking boats in



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Once the police helicopter added its apprehension of a band of kidnappers who tried to use corner pigeons for delivery of nitrocellulose, the helicopter ended the pursuit to the kidnappers' hideout. Another case out of the helicopter helped narcotics agents nab a drug peddler who had loaded trading for heroin. Detectives pointed a snail on the top of the suspect's car, followed him in air to a pickup, with the helicopter pointed to stand with the duo.

Second cases, prisoner escapes from Wallase Island have been foiled by the

Fine Copiers?

New York-Fox Lighting Instrument Division will play a role in Fox Department operations in the future. N. E. Fox, Commissioner Edward F. Connelley, Jr., told Aviation Week.

Commissioner Connelley was a lead for a rotary wing "fox copier" large enough to carry about 100 people, 500 gal chemical tanks, specially developed lightweight bombs with igniters and thermocouples for air-to-ground contact. Such equipment especially would be used in air-to-ground operations, such as to fight ground air bases, fire defense to reach over rough terrain.

Small rotary wing helicopter also are needed to transport Fox Department aircraft quickly to the scene of major blazes where they would perform direct operations from the air to aid. Fox Department has used borrowed Fox Department Bell 47s for such operations. Commissioner Connelley notes that if the department had its own small helicopter it would be used for such duties at least four times a month.

However, such equipment doesn't appear to be in the procurement stage of pursuit, the Commissioner says there is no more use in the department's budget for helicopters.

Several helicopter manufacturers, including Bell Helicopter and Vertol, have studied Fox lighting helicopter projects. Bell has been working with Aerial Chase and Co. in fitting a chemical dispensing boom on its Model 47 and demonstrating how the system can work in fire. Aerial currently is studying what is needed in the way of lightweight dispensing equipment.



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photo missions are flown for Board of Estimate to assess land sites subject to litigation and also to check area for new schools and other public buildings.

To cover its territory, the Bureau works out of a hangar located near the Navy at Floyd Bennett. Aerial patrols start at 8 a.m. and last through sunset in summertime when daylight saving time permits. This means the ships are shut until approximately 9 p.m.

Emergency Use

Naturally, missions are cancelled if wind exceeds 15 mph or if visibility is less than three-quarters of a mile, but in an emergency police helicopters have gone out even when these warnings have been cancelled. Once, after a hurricane, they went out in winds of up to 50 mph to rescue two small boats which had ventured out into choppy water on Fla. reefs. The weather was so rough that all hands were tied up and the helicopter beat a police launch that attempted the rescue from a distant point.

In the course of its operations, Aviation Bureau personnel have been awarded 1475 department commendations for their work.

Few helicopters, strategically located around the city, make it possible to have helicopters about five minutes away from the heliport point from each station. The main base is about 25 minutes away from the heliport point in the Bureau's jurisdiction. All of the helicopters return to main base each night. Although the helicopters are engaged for night flying, this is avoided because of the difficulty of locating anything after sunset except when a bright moon is out. Police helicopters put in approximately 16 hr. of night flying annually.

With five helicopters, the Bureau is able to have four ships available for duty at all times, the fifth being in overhaul. Each of the four ships flies 50-60 hr./month. On this basis, operating costs average that at approximately \$46/hr.

Low Overhead

Key to the low costs, of course, is low overhead. Pilots and maintenance personnel are uniformed officers drawn from Police ranks, with previous flying experience. Flying costs in made up of 21 pilots and 13 maintenance personnel. Two cents fly on each patrol.

Replacement for pilots who want to transfer to the Aviation Bureau is that they have at least a commercial pilot's rating; maintenance personnel have to have an ABE certificate rating. Some 30 ST pilot applications and about half that number of mechanics are usually on file with the Bureau.

Aviation Bureau is one of three units

belonging to NYNED's Emergency Services Division commanded by Deputy Chief Inspector William F. Katschick. The Bureau is in charge of Lt. Kenneth C. Johnston, an ex-USMC instructor with the Training Command who taught multi-engine transport pilots Lt. Johnston rose to the Police Department as a pilot in 1946, spent three years as the chief before transferring to the Aviation Bureau.

Pilot strength comprises Lt. Johnston, a sergeant, two acting sergeants and seven pilots. Maintenance personnel is made up of a sergeant and 12 personnel. Original group of pilots were trained at Bell Helicopter Corp.,

when it was based in Buffalo, N. Y., in 1948. Since then, new police pilots have been trained at Bell Helicopter by ex-Herald W. Rhodes.

Basic course uses Bell's training manual and comprises 15 hr. flight time, with considerable attention to emergency submaneuvers. Spot authorization landings are stressed in the course because the Bureau is operating single-engine helicopters over populated areas, although the majority of their flying actually is over water areas skirting the metropolis. According to Sgt. Rhodes, Bureau pilots have never experienced a full power failure. Sgt. Edwards is in charge of



SPERRY ANNOUNCES

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CARL G. HOLSENGER, President of Sperry Gyroscope Company

"In the years ahead, the nation's requirements for new and more efficient weapon systems, delivered at maximum speed and minimum cost, will impose greater demands on industry. For its part, Sperry is moving to meet these demands with the formation of our new Air and Surface Armament Divisions.

"Objective of this product-team reorganization within the Sperry organization is to assure more advanced design, shorter lead times and lower costs in the development of weapon systems in these two categories. Each division, with its own engineering, manufacturing and contract organization, includes specialists in radar, fire control, gyroscopics, navigation, inertial guidance and all the allied sciences essential in the engineering of complex weapon systems."

C. S. Holscher



SAMUEL AGHVIAN has been appointed Manager of the Air Armament Division. Formerly works manager, Mr. Aghvian is an Annapolis graduate and former Marine Corps officer. His work at Sperry has included responsibility for computing circuits, bandwidths, instrument devices, radar and related developments.



NELSON B. LOCKWOOD, manager of the Surface Armament Division, was formerly a systems engineering leader. A World War II Lt. Col. of Artillery, and industry-technical adviser at M.I.T., Mr. Lockwood has been associated with Sperry projects in underwater torpedo fire controls, guidance computers for missiles, antiaircraft control systems and aerial navigation equipment.

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Need for Specialized Research and Development Information

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Expansion of research and development procurement activities has brought the need for a Guide which will increase the understanding of procurement procedures and available facilities and capabilities. To satisfy this need, the Research and Development Edition, an outgrowth of editorial pioneering in this field as outlined later in this announcement, will provide the following specialized research and development information:

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Industry's vital and rapidly increasing role in research and development will be surveyed.

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facilities and capabilities are available, where they are and how to utilize them. Information on the marketing of research and development availability will be reported.

Newly revised government research and development contracting policies and procedures explained in detail.

GOVERNMENT

Missions, organizations and operating procedures of National Advisory Committee for Aeronautics; Air Research and Development Command; and Office of Naval Research summarized. Their laboratories, research stations and test center facilities, capabilities and availabilities analyzed in detail.

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Exhaustive report on the important research and development programs at work at various universities and independent establishments throughout the country. Particular attention is given to the procedures of sub-contracting these resources.

INTERNATIONAL

Exclusive coverage of overseas sources of research and development available to industry as reported by our Geneva, Switzerland office.

Pioneer Research and Development Coverage

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In 1956, AVIATION WEEK was called upon to publish a second Air Research and Development Command Edition to report the many changes, improvements and advances that had been made. It is now in use as a current standard reference and training aid on research and development.

AVIATION WEEK's 25 full-time graduate engineers and aviation specialists located in key aviation centers throughout the world will provide the editorial manpower and know-how far in excess of research and development service editors. Their extensive experience in this field which was pro-

duced editorially by AVIATION WEEK assures an information-packed Guide of outstanding usefulness and serviceability.

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As such modern advances, even fractional errors in inlet-air diffuser positioning reduce thrust tremendously.

Yet a fixed diffuser designed for optimum pressure at a given high Mach number may be no reference at a lower Mach number so as to make it impossible for aircraft to reach design speed.

In the U.S.A.F.'s latest supersonic fighter, General Dynamics' B-58 Hustler, this problem was solved by Honeywell's variable inlet-air diffuser system—the most accurate known. They are automatically controlled to the proper parameters to achieve maximum pressure recovery and mass air flow matched to engine requirements.

The Challenges to Come!

Viable inlet diffuser systems are just one of 314 research and development projects in which Honeywell firms are engaged. These projects are in the basic areas of:

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Each of these projects offers exceptional career opportunities for capable engineers and scientists.

And Honeywell really grows you as early advancement Engineering personnel at Honeywell learn far beyond in the best 5 years, it will grow faster than the average industry average. Superior position open quickly, are filled from within. The benefits they you meet with at Honeywell is just the start.

Write today!

For more information concerning these opportunities, and requirements please write to: Branch D, Speed, Systems Division, Dept. TA90, Honeywell, Inc., 1430 S.W. Ave., Redmond, Washington 98073.

Honeywell
Aeronautical Division

Certificates of Necessity

Washington—Office of Defense Mobilization has awarded United Aircraft Corp., Pratt and Whitney Aircraft Division's new Pulse Reactor Co., the Facility a certificate of necessity for accelerated air transportation in the amount of \$36,975,000 for research and development with 70% of the amount certified allowed.

General Dynamics Corp., Cosmo Division, San Diego was awarded a certificate for research and development in the amount of \$17,032,600 with 60% allowed. Other certificates awarded:

Aircraft General Corp., Sacramento, Calif., research and development \$211,000 with 60% allowed.

Lockheed Corp., Los Angeles, military aircraft components \$221,000 with 60% allowed.

Advanced Machine Co., Philadelphia, Md., military aircraft \$200,000 with 60% allowed.

Western Electric Co., Inc., Mountain View, N.Y., military electronic components \$100,000 with 60% allowed.

Western Electric Co., Inc., Mountain View, N.Y., military electronic components \$100,000 with 60% allowed.

United Aircraft Corp., East Hartford, Conn., military aircraft engines \$11 million with 60% allowed.

General Dynamics Corp., Fort Worth, Texas, military aircraft engines \$11 million with 60% allowed.

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WAITING FOR A CHANGE

Development of aircraft and aero engine design is a pattern of never ending change and modification. Improving engines and structures demands more strength in more and better parts. Example: There are about 1,300 machined parts in the F-105A. In the F-104D, improvements have added 100 more. Higher power and speeds in the same size airframe call for improved elevated temperature performance in alloys for structures, fasteners and fasteners.

The big problems have been the formability and machinability of the tough alloys used in the intermediate elevated temperature applications. But this is being solved. Carpenter is now producing uniform elevated temperature alloys of very high quality which consistently meet tough aircraft specifications. These quality and cleanliness also allow heightened forging tolerances, improve machinability and cold forming properties. Result: More accurate forgings with better finishes . . . fewer rejects . . . better production.

Complete information on applications, fabrication and engineering properties of these alloys is contained in our new booklet, "Carpenter Alloys for Elevated Temperature Service." For your copy, drop us a line on your Company letterhead. The Carpenter Steel Company, 138 W. 30th Street, Reading, Pa.

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\$100,000 for completion of 1000 Kilo-
Bytebus and 1000 Kilo-Bytebus
\$100,000 for completion of 1000 Kilo-
Bytebus and 1000 Kilo-Bytebus

General Electric Co. Small Aircraft
Engine Department, New York, N.Y., 11-
115-114 for 1000 Kilo-Bytebus engine
\$100,000 for completion of 1000 Kilo-
Bytebus and 1000 Kilo-Bytebus

General Electric Co. Small Aircraft
Engine Department, New York, N.Y., 11-
115-114 for 1000 Kilo-Bytebus engine
\$100,000 for completion of 1000 Kilo-
Bytebus and 1000 Kilo-Bytebus

General Electric Co. Small Aircraft
Engine Department, New York, N.Y., 11-
115-114 for 1000 Kilo-Bytebus engine
\$100,000 for completion of 1000 Kilo-
Bytebus and 1000 Kilo-Bytebus

CAA Contracts

Washington—Following is a list of
contracts awarded by the Civil Aeronautics
Administration

General Electric Corp., Washington, D.C.,
\$100,000 for 1000 Kilo-Bytebus engine

General Electric Corp., Washington, D.C.,
\$100,000 for 1000 Kilo-Bytebus engine
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Navy Contracts

Following is a list of substantial contracts of \$25,000 and over as released by Navy Contracting Office:

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Submarine North American Aviation, Inc.—*1700 E. 10th Ave., P. O. Box 25, St. Louis 17, Mo.*—*1000-1000.*
Submarine North American Aviation, Inc.—*1700 E. 10th Ave., P. O. Box 25, St. Louis 17, Mo.*—*1000-1000.*

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Tool designers are needed for manufacturing the components that require a minimum of three years experience in the design of jet engines and parts for other manufacturing or in operation as required.

Product Design

Product designers are for designers to work on improvements in present jet engines as well as design new ones for the future. Previous engine design experience is desirable along with three years of product design.

YOUR INTEREST DATA, ALL DAY AND MAIL COUPON TODAY!

Dear Mr. Van Auken:

I am interested in full details about an opportunity at General Electric as a Designer. Please send me an application. I understand all replies are held in strictest confidence.

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Mr. David D. Brown, Dept. V-150
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The Missile and Ordnance Systems
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Position Requirements:

- BSCE with electronics major
- Minimum of four years' experience in the synthesis and/or operation of electronic instrumentation systems and electronic circuitry

Position Responsibilities:

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- Establish and specify instrumentation systems and instrumentation, such as, power supply requirements, component test, design and weight, coding and connection points, and external interconnections.
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AVIATION WEEK, April 18, 2002



Intercontinental Peacemaker

Long arm of SAC's deterrent force, Boeing Airplane Company's intercontinental B-52 has as its nerve center the AN/ASB-4 Bombing/Navigation System, developed and produced by International Business Machines for the United States Air Force.

Aside from pinpoint navigational and bombing accuracy, this complex system is notable for a high level of reliability achieved by painstaking care in detail design, rigorous proofing of each part, and a system configuration comprising unit-tested modules.

Servomechanisms, Inc., in addition to quantity production of the Pressure Transducers and Quadrature

Rejector units which are important input and control elements of this system, has also contributed to the development of several other important elements of this system.



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